S
711.7
H3u
Vol. III

STATE DOCUMENTS

GREAT FALLS

MONTANA STATE LIBRARY
930 East Lyndale Avenue
Helena, Montana 59601

PLEASE RETURN

URBAN TRANSPORTATION SURVEY 1961

VOLUME III

MONTANA STATE LIBRARY
S 711.7 H3u c.2 v.3
Urban transportation survey of Great Fal
3 0864 00061033 0

URBAN TRANSPORTATION SURVEY

of

GREAT FALLS, MONTANA

CONDUCTED BY

MONTANA STATE HIGHWAY COMMISSION

PLANNING SURVEY DIVISION

IN COOPERATION WITH

U.S. DEPARTMENT OF COMMERCE

BUREAU OF PUBLIC ROADS

AND THE

CITY OF GREAT FALLS

VOLUME III

MARCH 1964

PREPARED BY

PLANNING SURVEY DIVISION

OF

MONTANA STATE HIGHWAY COMMISSION

PROJECT STAFF:

Howard T. Buswell
Planning Survey Manager

Paul R. DeVine
Assistant Planning Survey Manager

Robert A. Garber and Robert J. Stainsby
Analysts

Allen C. Stenhjem and Floyd G. De La Hunt
Draftsmen

With Valuable Assistance
From Personnel Of:

BUREAU OF PUBLIC ROADS

AND

CITY OF GREAT FALLS

TABLE OF CONTENTS

	PAGE
List of Exhibits	ii
Definition of Technical Terms	1
Introduction	6
Survey Summary	10
The Major Street Network	14
Street Classification and Length	18
Right-of-Way Widths	18
Pavement Widths	19
Pavement Types	20
Present Traffic Volumes	26
Average Daily Traffic Volumes	26
Peak Hour Traffic Volumes	28
Hourly, Daily, and Monthly Variations	28
Vehicle Miles of Travel	33
The Quality of Traffic Service	36
Average Driving Speeds	36
Average Delay Rates	37
Driving Time From Central Business District	40
Traffic Capacities of Intersections	42
Bridge Capacities	46
Traffic Accidents	47
Accident Rates	48
Collision Diagrams	52
Traffic Assignment to the Present Network	66
Description of Computer Program	66
Screen Line Check	70

LIST OF EXHIBITS

EXHIBIT NUMBER	DESCRIPTION	PAGE
1	All Roads and Streets in Survey Area	16
2	Selected Major Street Network	17
3	Right-of-Way Widths	20
4	Pavement Widths	21
5	Pavement Types	23
6	Average Daily Traffic Flow	27
7-9	Peak Hour Turning Movements	29-31
10	Hourly, Daily, and Monthly Variations	32
11	Average Driving Speeds - Peak Hour	38
12	Average Delay Rate Per Vehicle - Peak Hour	39
13	Average Driving Time From Central Business District.	41
14	Location of Signalized Intersections	44
15	Traffic Capacity of Signalized Intersections	45
16	All Accident Rate - Major Street Network	49
17	Injury Accident Rate - Major Street Network	51
18-27	Collision Diagrams	55-64
28	Map Showing Nodes and Loading Points	67
29	Comparison of Computer-Assigned Traffic Volumes with Actual Volumes	69

D E F I N I T I O N S

ACCIDENT RATES

All Accident Rate

Is expressed as the number of accidents occurring during 10 million vehicle miles of travel.

Fatal and Nonfatal Injury Rates

Both of these rates are expressed as the number of fatalities and nonfatal injuries occurring during 100 million vehicle miles of travel.

COMPUTER TERMINOLOGY

Link

A portion of the major street network between two nodes.

Minimum Path

The shortest route by time on the major street network from a point of origin to a point of destination.

Network Description

A record which describes in computer language a street or highway system in terms of nodes, links, and operational characteristics.

Node

A numbered point representing an intersection or zone centroid.

Traffic Assignment

A process which estimates vehicular volumes that will use each individual portion of the major street network.

Tree

A record showing the shortest time paths from a given node to all other nodes on the major street network.

Zone Centroid

That point which is designated to represent the center of trip ends in a zone.

INTERSECTION CAPACITY

Possible Capacity

The possible traffic capacity of an intersection approach is the maximum number of vehicles that can actually enter the intersection from that approach during one hour with a continual backlog of waiting vehicles. Possible capacity is approximately 20 percent greater than practical capacity.

Practical Capacity

The practical traffic capacity of an intersection approach is the maximum number of vehicles that can enter the intersection from that approach during one hour with most of the drivers being able to clear the intersection without waiting for more than one complete signal cycle.

RATES OF MOTION

Delay Rate

The difference between the observed rate of motion and the standard rate of motion. It is usually expressed in minutes per mile of excessive delay for each vehicle.

Observed Rate

The average speed attained by vehicles expressed in minutes per mile.

Standard Rate

The desirable speed expressed in minutes per mile that should be attained while traversing a given street section.

STREET CLASSIFICATIONS

Arterial Street

A major street that interconnects traffic generators and important rural highways entering the city. It serves relatively large movements of traffic, and also performs a secondary service function to adjacent land.

Collector Street

A street that serves the internal traffic movements within an area of the city and connects this area and its local streets with arterial streets. A collector street provides service to all adjacent property and local traffic movements.

Expressway

A multilane, divided street facility with few, if any intersections at grade. This type of facility is used almost entirely to move traffic on relatively long trips with very little service to the abutting land.

Local Street

Provides access to abutting property regardless of land use. This type of street accounts for a large percentage of the total street mileage but carries only a small percentage of the total vehicle miles of travel.

Major Street Network

That portion of the entire street system which serves the major traffic movements.

TRAFFIC VOLUMES AND TRAVEL MEASUREMENT

Average Daily Traffic Volume

The average 24-hour volume of traffic that passes a particular point during a specified year, month, or week.

Design Hour or Thirtieth Maximum Hourly Traffic Volume

The hourly volume of traffic passing a particular point that is exceeded by 29 higher hourly volumes during any year. In an urban area, the design hour volume approximates 10 percent of the average daily traffic volume for the year.

Peak Hour Traffic Volume

The maximum number of vehicles that pass a particular point during any one hour of a specified period. The peak hour of traffic usually occurs between 4 p.m. and 6 p.m. in an urban area.

Vehicle Miles

A measure of vehicular travel consisting of the product of the number of yehicles and miles each is operated.

Digitized by the Internet Archive
in 2017 with funding from
Montana State Library

https://archive.org/details/urbantransporta1962grea_1

Introduction

I N T R O D U C T I O N

The Great Falls Urban Transportation Study is a joint effort between the city of Great Falls, the United States Bureau of Public Roads and the Montana Highway Commission. It was initiated in 1961 for the single purpose of providing an adequate, long range transportation plan for the study area.

Due to the fact that a complete study of this kind necessarily takes a considerable amount of time, it was decided to publish various phases of the complete study as the related data were developed. In conformity with this decision, four volumes are to be published as shown below:

Volume I

- Introduction
- Description of Various Surveys
- History and Development of Great Falls
- The Parking Survey
- Internal Cordon Counts

Volume II

- External Cordon Origin-Destination Studies
- Home Interview of Internal Passenger Car Trips
- Truck and Taxi Survey
- Present Land Use Inventory

Volume III

- Major Street Inventory and Classification
- Present Traffic Volumes and Controls
- Traffic Capacity of Signalized Intersections
- Accident Data
- Present Traffic Assignment

Volume IV

Summary of All Data and Recommendations

Forecasts of Future Population Traffic and Development

Recommended Transportation Plan

As Volume III, this report describes the various surveys that were necessary to obtain data on the present major street network. The results of these surveys are used to determine the quality of traffic service that is presently provided by the major street network.

Survey Summary

S U R V E Y S U M M A R Y

There were 236 miles of roads and streets in the study area of Great Falls as of December 31, 1962. A major street network composed of 77 miles of arterial and collector streets was selected for study.

A maximum traffic volume of 22,500 vehicles per day was counted on 10th Avenue South between 10th and 11th Streets. The average weekday traffic volume in 1961 was 1,538 vehicles per day on all roads and streets within the survey area. There were about 363,000 vehicle miles of travel generated on all streets within the survey area. Each person residing within the survey area traveled an average of 4.9 miles within the area on an average weekday in 1961.

The peak hour of travel occurred between 4:30 and 5:30 in the evening on an average weekday. The traffic volume during this one-hour period amounted to about 10% of the 24-hour volume on an average weekday.

Evening peak hour speeds dropped below 10 miles per hour on the following sections of city streets:

Central Avenue between Park Drive and Ninth Street

Park Drive between Second Avenue North and First Avenue South

Smelter Avenue between U.S. 87 and Rainbow Ryan Road

Ninth Street between Second Avenue North and First Avenue South

Almost all sections of the survey area are within a maximum driving time of 12 minutes from the Central Business District.

There were seven signalized street intersections that were operating at or above practical traffic capacity during the survey. Ten intersections were operating within 10% of practical traffic capacity.

The 10th Avenue South bridge over the Missouri River was operating at about 5% above practical traffic capacity in 1961.

About 70% of all accidents in the survey area occurred on the major street network during the three-year period 1960-1962. The selected major street network is composed of 77 miles of streets which represent 33% of the total street mileage within the study area.

The average rate for all accidents on the major street network was 144.2 accidents per 10 million vehicle miles of travel during the three-year period of 1960-1962. The injury accident rate was 68.9 and the fatal accident rate was 5.1 per 100 million vehicle miles of travel on the major street network during the same three-year period.

Ten intersections had a total of 667 accidents in the three-year period of 1960-1962. These accidents amounted to about 9% of the total accidents that occurred within the area on all streets during the same period.

The Major Street Network

THE MAJOR STREET NETWORK

A major street network, as defined for this report, is that portion of the entire street system which serves the major traffic movements. A selected network of this type is composed of expressways, if any, arterial streets, and collector streets.

In the Great Falls study area, there are about 236 miles of roads and streets as shown in Exhibit 1 on page 16. Of this total, about 77 miles, or 33 percent, have been selected for a major network study. The present major network, as selected, is shown in Exhibit 2 on page 17. The mileage contained in this network is classified in the tabulation on page 18.

The selection of the major street network was based primarily on the previous establishment of any street as a "through" street by ordinance or local use. The designated network includes almost all of such "through" streets. Other considerations in the selection of streets that have been placed on the network were vehicle volumes, location, and system continuity.

Streets included in Great Falls' major network are classified into two main types, major arterials and collector streets, according to the services they presently provide to traffic and adjacent land.

At present, there are no constructed freeways or expressways within the Great Falls study area and no local streets have been included in the major street network.

The two types of streets included in Great Falls' major network and the principal functions of each type are as follows: 1/

1. Major Arterials - should provide connections between major

1/ Street classifications and definitions as recommended by The National Committee on Urban Transportation, Procedural Manual-1A.

traffic generators and important rural highways. Their main function is to move relatively large volumes of traffic on long trips within or through the metropolitan area. They also should perform a secondary service to adjacent land.

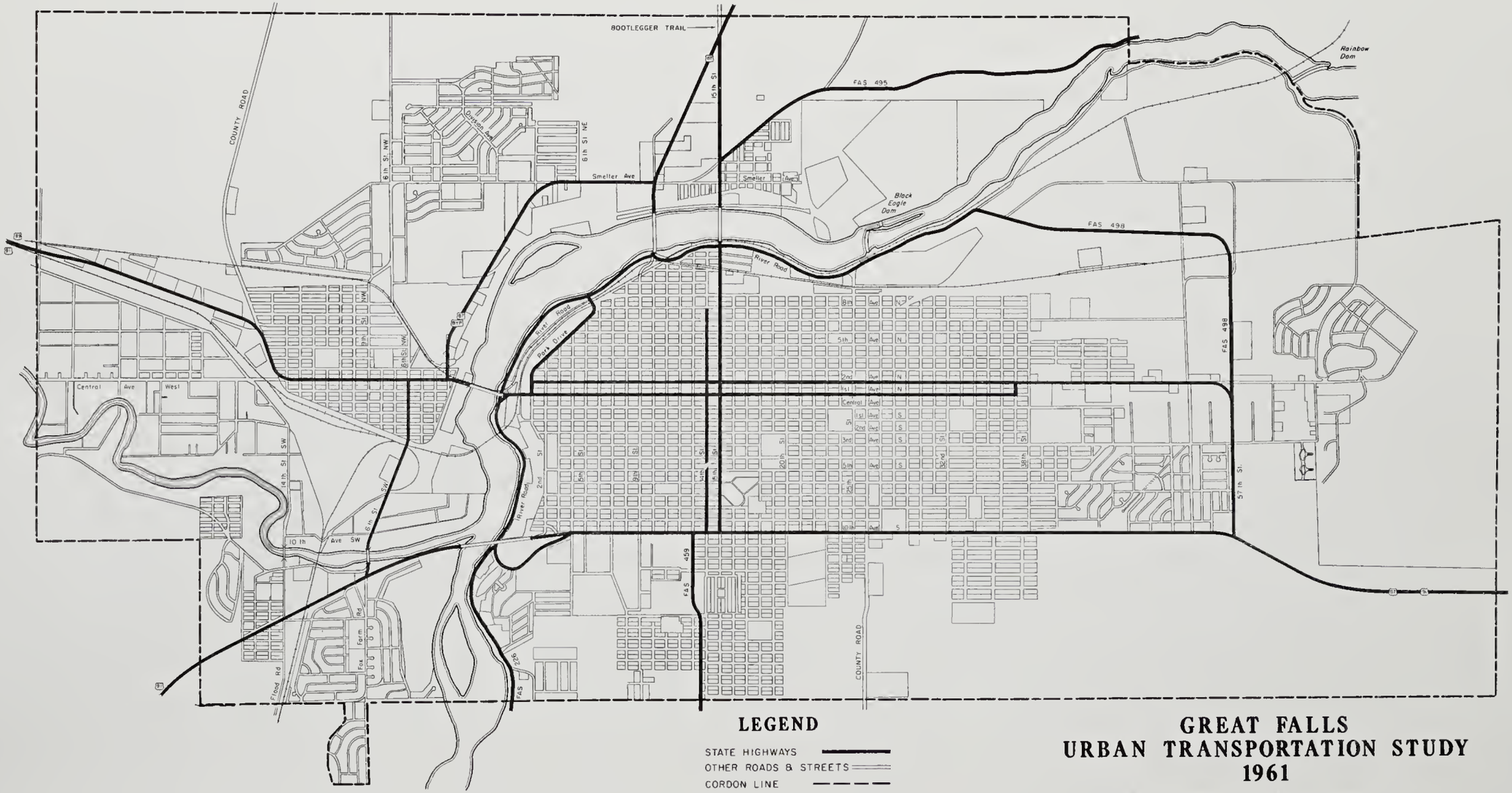
If properly located and developed, a major arterial system should help to define residential neighborhoods, industrial sites, and commercial areas. The arterial street in its ideal location should also minimize conflicts between school and park developments. To insure sufficient traffic capacity and a high level of service, major arterial streets should not be located more than one mile apart.

2. Collector Streets - This class of streets serves the internal traffic movement within an area of a city and connects this area and its local streets with the arterial system. These streets ordinarily do not handle long, through trips and may not be continuous for any great length. In gridiron patterns such as the streets of Great Falls, a street of several miles in length may be serving as a collector rather than an arterial if the predominant use is to reach the first arterial and then turn off.

This system of streets is intended to supply adjacent property with the same level of service as a local street while at the same time providing a high level of traffic movement within an area.

Network mileages and percentages in each of the two classifications are shown in the tabulation on page 18.

EXHIBIT I



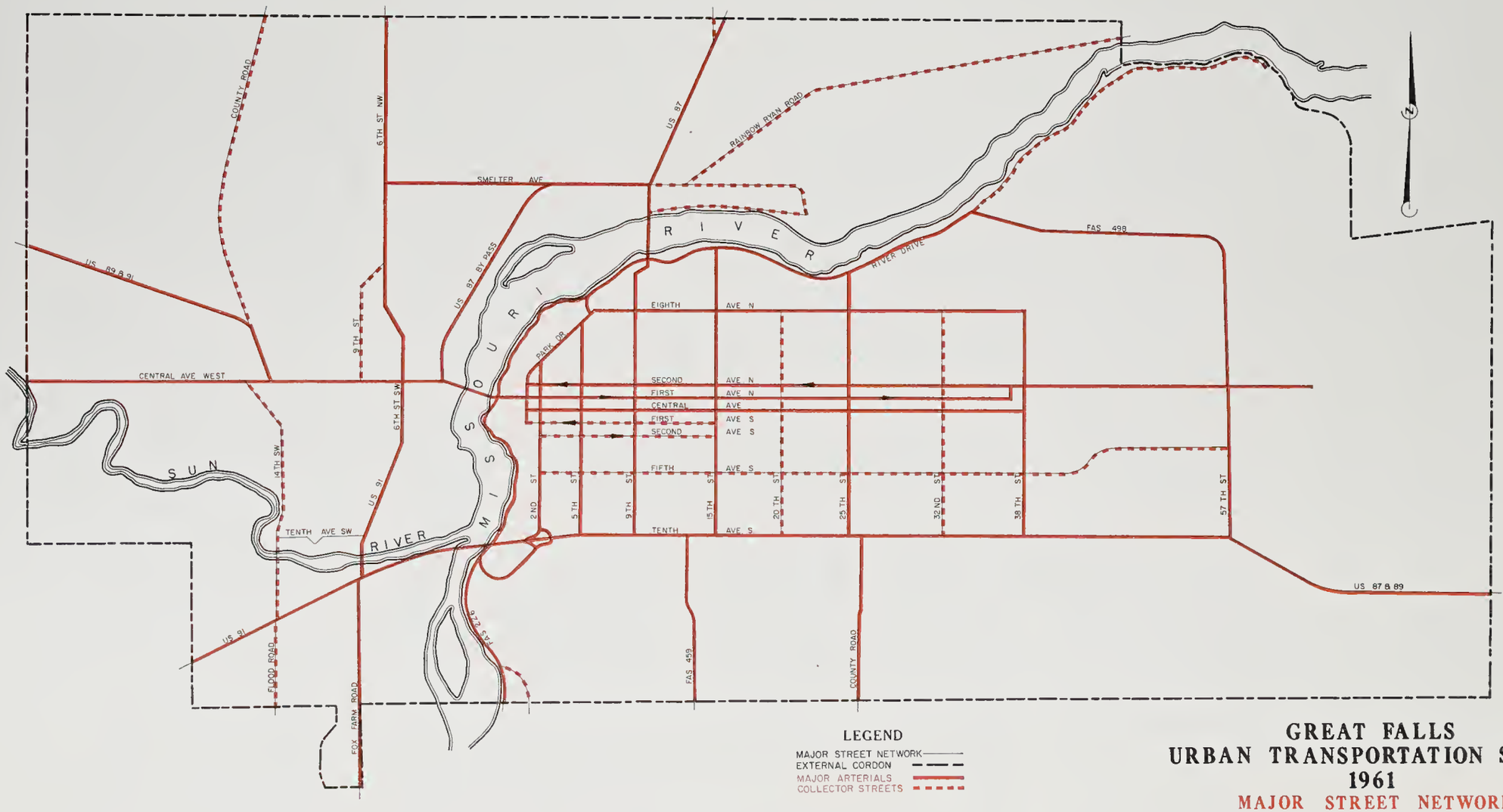
LEGEND

STATE HIGHWAYS
OTHER ROADS & STREETS
CORDON LINE

GREAT FALLS URBAN TRANSPORTATION STUDY 1961

ALL STREETS & HIGHWAYS WITHIN THE STUDY AREA

EXHIBIT 2



LEGEND

MAJOR STREET NETWORK
EXTERNAL CORDON
MAJOR ARTERIALS
COLLECTOR STREETS

GREAT FALLS URBAN TRANSPORTATION STUDY 1961

MAJOR STREET NETWORK STREET CLASSIFICATION

Street Classification	Network Mileage	Percent of Network Mileage	Percent of Total Street Mileage
Major Arterial	54.3	68.8	23.0
Collector	22.7	31.2	9.6
TOTAL	77.0	100.0	32.6

The major street network, as shown in Exhibit 2 on page 17, represents what was in existence in 1961. It may or may not be an adequate or desirable system. It will, however, be examined and appraised and will become the base for future planning.

GREAT FALLS

RIGHT-OF-WAY WIDTHS

Great Falls is fortunate that its founder, Paris Gibson, had the foresight to provide a minimum right-of-way width of 80 feet for the streets and avenues in his original townsite. Central Avenue, which became the main street of the city, was originally laid out with a 90-foot right-of-way.

Through the years since Great Falls was founded, the city officials and the City-County Planning Board have generally adhered to a policy of requiring that adequate street right-of-way widths be dedicated in proposed subdivisions before annexing them to the city. The orderly development of subdivisions in the past has also been quite strictly controlled by the simple policy of not furnishing city water to residents outside the corporate limits. These two factors have been a great influence in the orderly development of Great Falls from the original townsite to its present size.

The present policy of the City-County Planning Board requires a minimum of 60 feet of right-of-way for local residential streets and from 70 to 80 feet for collector and arterial streets in potential subdivisions.

In order to properly plan improvements, it is quite necessary to have adequate information on existing street rights-of-way. This information was

obtained from the files of the City, County and State. The results of this right-of-way inventory of the major street network is illustrated in Exhibit 3 on page 20.

PAVEMENT WIDTHS AND TYPE

The width and type of pavement on existing streets are both very important factors in determining how well the existing streets will be able to carry future traffic volumes. An inventory of existing curb-to-curb or pavement widths on the major street network is illustrated in Exhibit 4 on page 21.

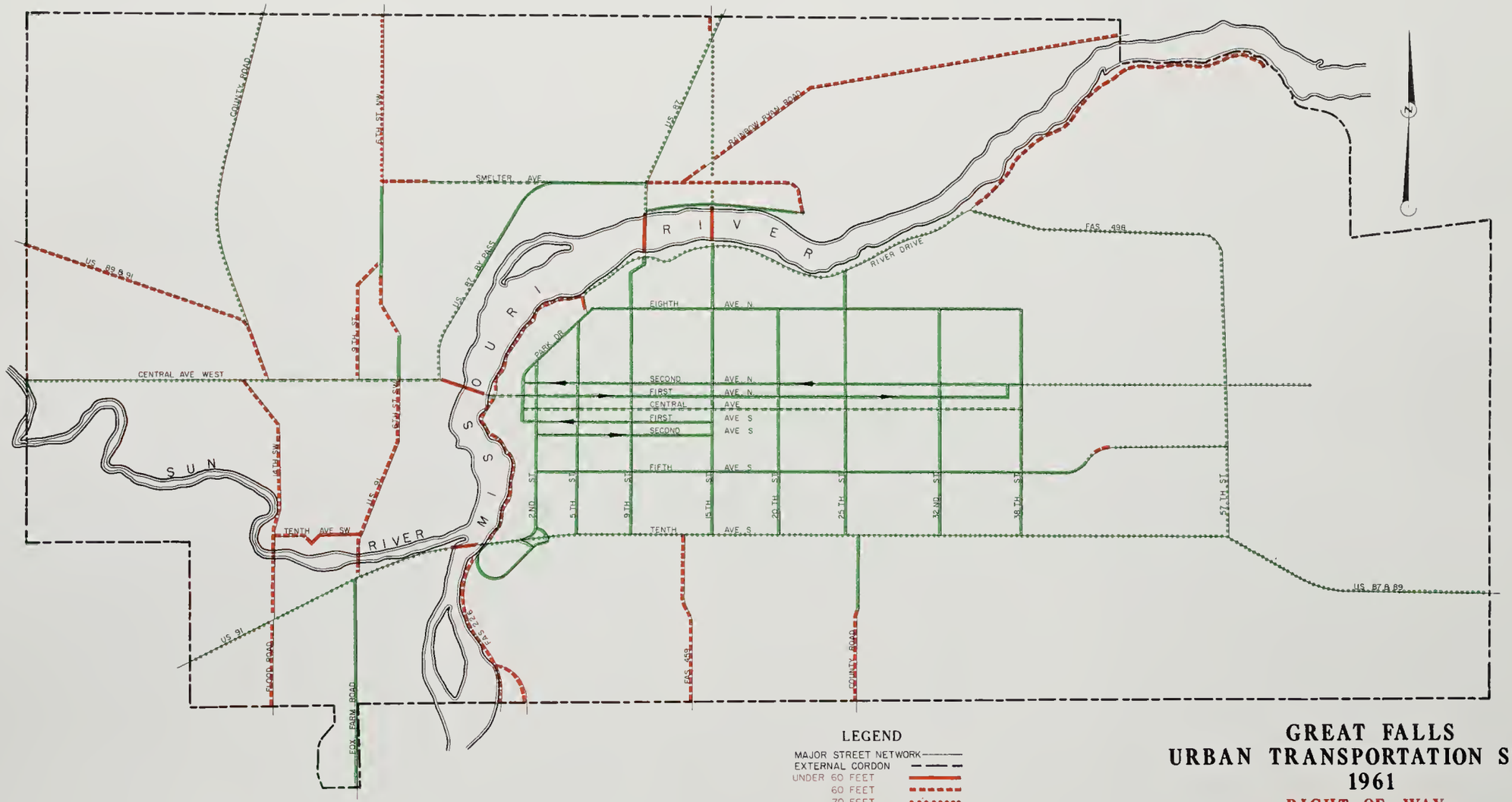
This inventory indicates that pavement widths in the Central Business District are generally 51 feet with the exception of Central Avenue which is 10 feet wider. Curb-to-curb widths of major streets through the residential areas are generally 35 feet due to an 8-foot outside boulevard on each side which has been planted to grass and trees. These boulevards are very attractive, but they reduce the effective street width from 51 to 35 feet in the residential areas.

One-way couplets have been instituted by the city on First and Second Avenues North between Park Drive and 37th Street, and First and Second Avenues South between 2nd and 15th Streets. These couplets effectively expedite the movement of traffic over sections of narrow streets.

Sections of streets that are now operating as four-lane facilities are listed in the following tabulation:

STREET	DESCRIPTION	PAVEMENT WIDTH (FT.)
2nd Avenue North	37th St. - Malmstrom A.B.	88 (Divided)
1st Avenue North	U.S. 87 Bypass - Park Drive	42-68
Central Avenue East	Park Drive - 15th Street	61

EXHIBIT 3

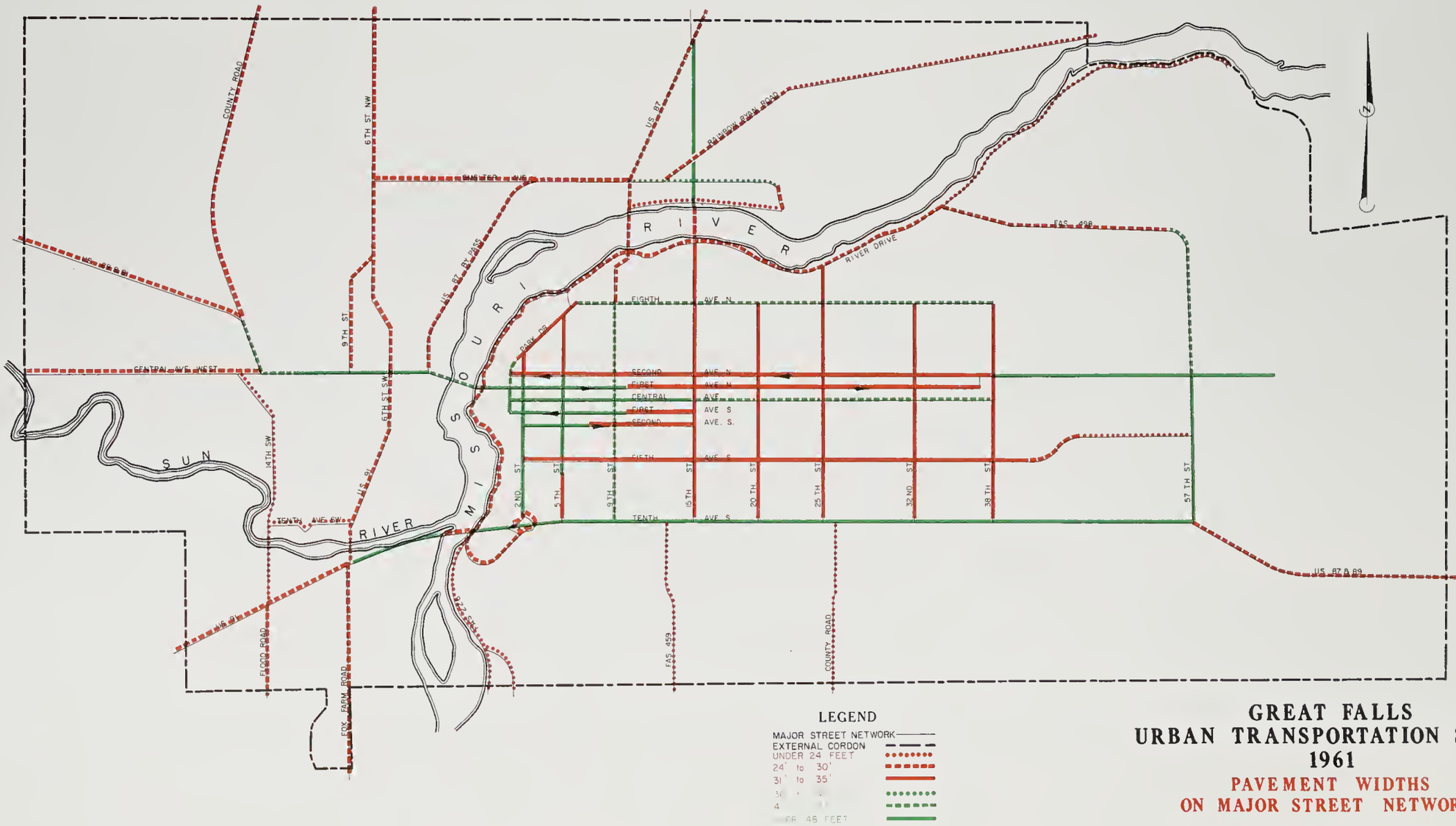


LEGEND

- MAJOR STREET NETWORK
- EXTERNAL CORDON
- UNDER 60 FEET
- 60 FEET
- 70 FEET
- [illegible] FEET
- 90 FEET
- [illegible] FEET

GREAT FALLS
URBAN TRANSPORTATION STUDY
1961
RIGHT-OF-WAY
WIDTHS
ON MAJOR STREET NETWORK

EXHIBIT 4



LEGEND

- MAJOR STREET NETWORK
- EXTERNAL CORDON
- UNDER 24 FEET
- 24' to 30'
- 31' to 35'
- 36' [illegible]
- 4[illegible]
- FOR 48 FEET

GREAT FALLS
URBAN TRANSPORTATION STUDY
1961

PAVEMENT WIDTHS
ON MAJOR STREET NETWORK

STREET	DESCRIPTION	PAVEMENT WIDTH (FT.)
Central Avenue West	U.S. 89 & 91 - U.S. 87 Bypass	42-80
10th Avenue South	Fox Farm Road - Worden Bridge	80 (Divided)
10th Avenue South	Worden Bridge - 57th Street	62-80 (Divided)
57th St. (U.S. 87 Bypass)	10th Avenue South - 2nd Ave. N.	82 (Divided)

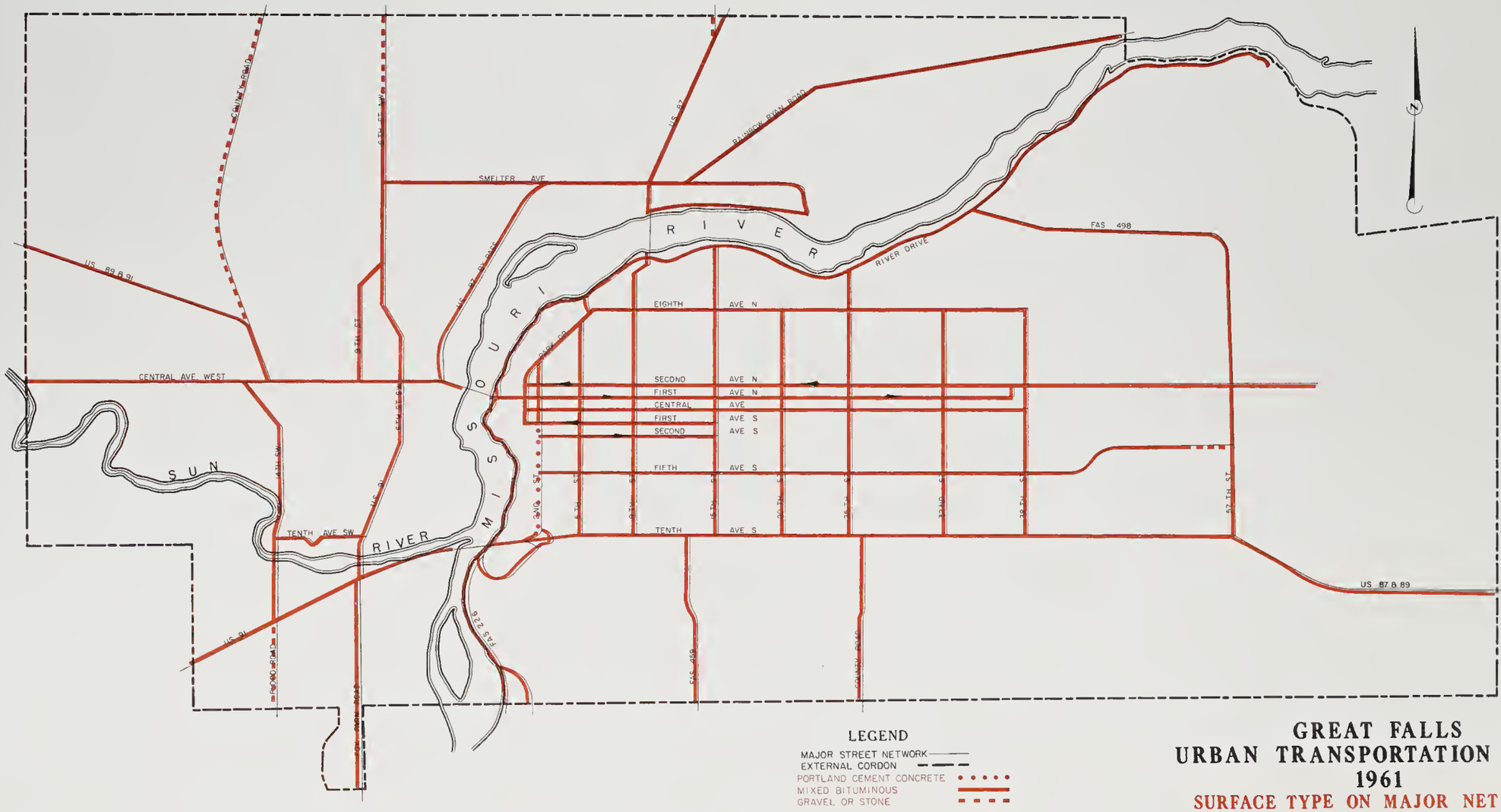
Exhibit 5 on page 23 shows the pavement types that existed on the major street system as of December 31, 1961.

The residents of Great Falls initiated a large street paving project in 1956. This improvement district included the major portion of the existing city streets east of the Missouri River. High type bituminous paving was completed on about 90 miles of city streets under this one contract. Streets in the subdivisions that have subsequently been annexed to the city have generally been paved within a short time after annexation.

The following tabulation summarizes the various pavement types on the major street network in the Great Falls Study Area. Mileages shown are as of December 31, 1961.

PAVEMENT TYPE	MILES
Unsurfaced	---
Gravel or stone	3.0
Bituminous	73.3
P.C. concrete	0.7
TOTAL MILES	77.0

EXHIBIT 5



LEGEND

- MAJOR STREET NETWORK
- EXTERNAL CORDON
- PORTLAND CEMENT CONCRETE
- MIXED BITUMINOUS
- GRAVEL OR STONE

GREAT FALLS
URBAN TRANSPORTATION STUDY
1961
SURFACE TYPE ON MAJOR NETWORK

Present Traffic Volumes

PRESENT TRAFFIC VOLUMES

Adequate traffic data provide one of the more important requirements in any complete evaluation of a major street network. It is necessary to establish hourly, daily, and seasonal traffic patterns to determine how the present street network is handling the traffic load.

AVERAGE DAILY TRAFFIC VOLUMES

Exhibit 6 on page 27 illustrates the average daily traffic volumes that used the major street network in Great Falls during 1961. Traffic volumes are represented by flow bands plotted to scale. This illustration is a composite of about 220 hourly-recording machine counts taken during the summer and fall of 1961. These counts were of at least 24 hours duration and have been adjusted to an annual average by the application of seasonal factors.

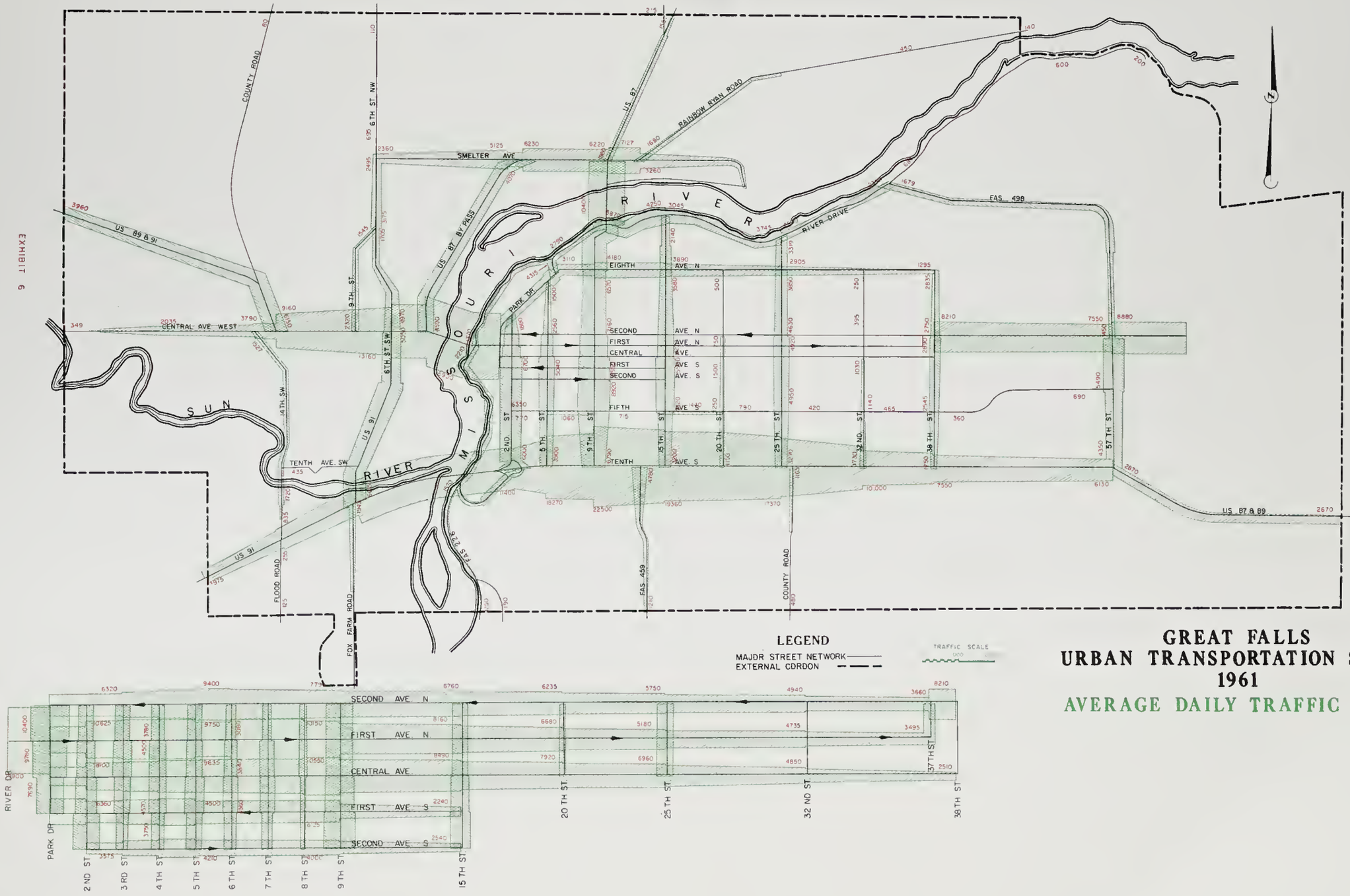
The predominant flow of east-west traffic will be readily noted on Exhibit 6. This can be attributed to the large residential section east of the Central Business District and the location of Malmstrom Air Force Base on the east edge of the study area. A maximum volume of 22,500 vehicles per day was recorded on 10th Avenue South between 10th and 11th Streets.

Ninth Street, which is designated as U.S. 87, was carrying the heaviest north-south traffic movement. Traffic volumes on this major arterial street ranged from 6,570 to 10,400 vehicles per day.

The three bridges crossing the Missouri River carried the following average daily traffic volumes for 1961:

Location	Average Daily Traffic
Tenth Street	10,400
First Avenue North	18,900
Tenth Avenue South	11,400
TOTAL TRAFFIC	40,700

EXHIBIT 6



GREAT FALLS
URBAN TRANSPORTATION STUDY
1961
AVERAGE DAILY TRAFFIC FLOW

The First Avenue North bridge is a four-lane facility while the other two bridges were each carrying two lanes of traffic.

PEAK-HOUR TRAFFIC VOLUMES

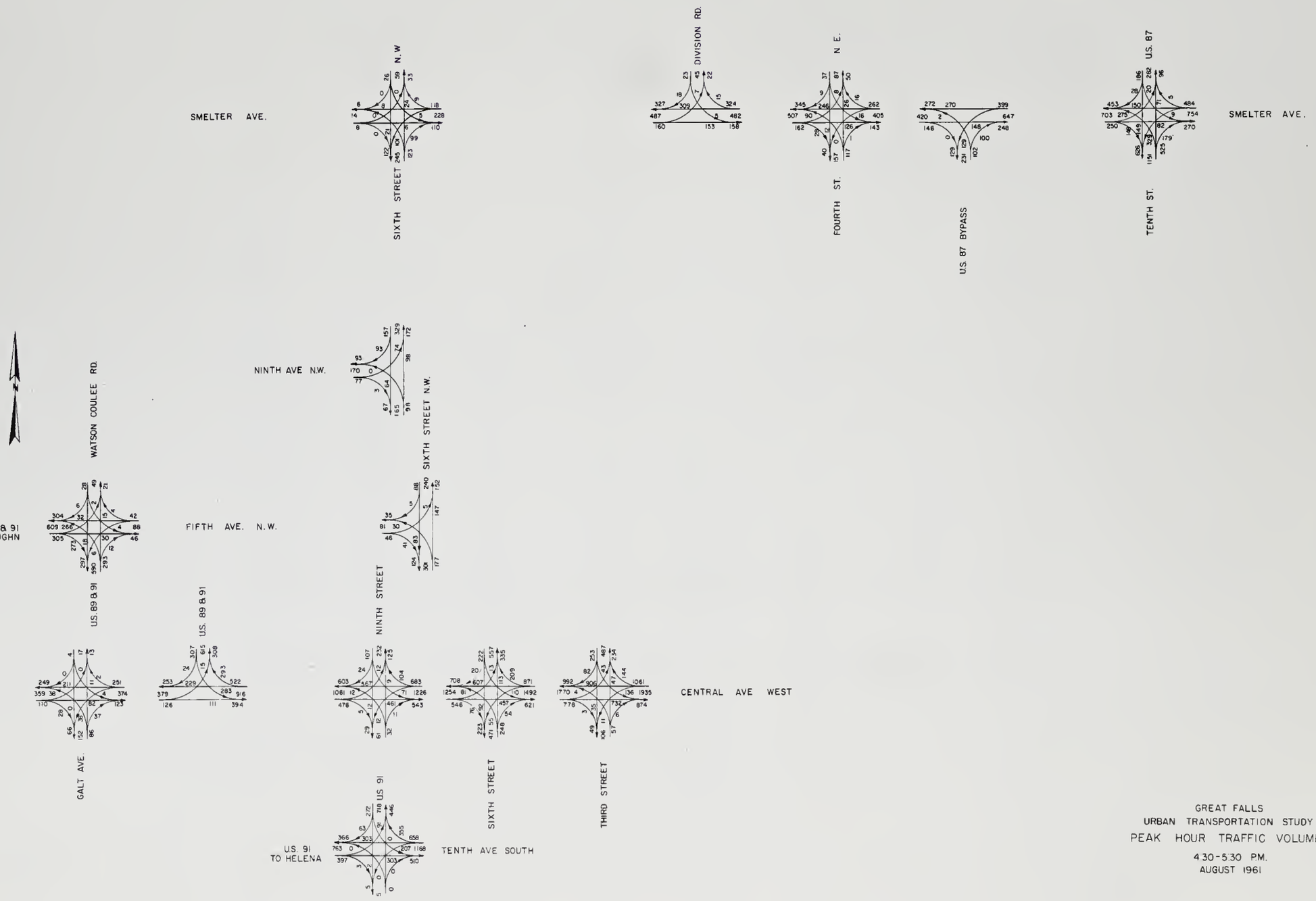
Turning movement counts during the peak hours of travel were made at 116 intersections on the major street system. Each intersection was counted during the hours of 7 a.m. - 9 a.m., 10 a.m. - 2 p.m., and 4 p.m. - 6 p.m. in order to cover the morning, noon, and evening peak hours of travel. Traffic was counted and classified by 15-minute intervals during these 8 highest hours.

The peak hour of travel occurred between 4:30 p.m. and 5:30 p.m. on an average weekday and amounted to about 10 percent of the 24-hour traffic volume. Hourly peaks of lesser magnitude occurred between 7:30 a.m. and 8:30 a.m. and between 12 noon and 1:00 p.m. The morning and evening peak hours found in Great Falls fit the traffic patterns for most cities, but the comparatively large volume of traffic during the noon hour is a characteristic of a city small enough to enable a high percentage of the residents to eat lunch at home.

The evening peak hour of travel on the major street network is illustrated in Exhibits 7, 8, and 9 on pages 29 through 31. The traffic volumes and turning movements shown in these exhibits were incorporated into the necessary calculations that were made to determine peak-hour traffic capacity at signalized intersections.

Hourly, Daily, and Monthly Traffic Volumes

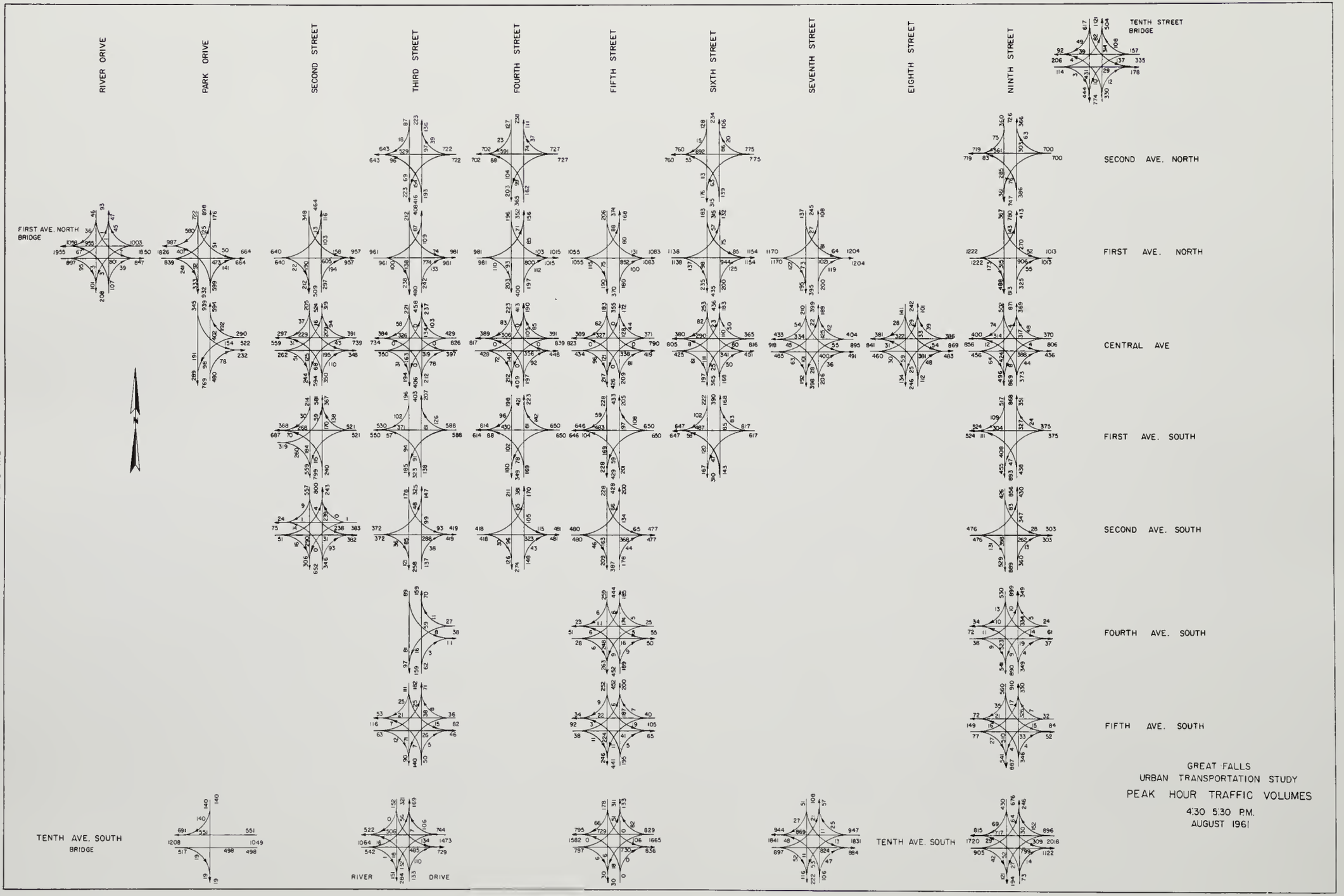
Exhibit 10 on page 32 illustrates the fluctuations in hourly, daily, and monthly traffic volumes that were found in the Great Falls study area. Hourly volumes are shown as a percentage of the average weekday 24-hour traffic. They are a composite of selected 24-hour counts taken both in the Central



GREAT FALLS
URBAN TRANSPORTATION STUDY
PEAK HOUR TRAFFIC VOLUMES
4:30-5:30 P.M.
AUGUST 1961

EXHIBIT 7

EXHIBIT 8



GREAT FALLS
URBAN TRANSPORTATION STUDY
PEAK HOUR TRAFFIC VOLUMES
4:30 5:30 P.M.
AUGUST 1961

GREAT FALLS
URBAN TRANSPORATION STUDY
PEAK HOUR TRAFFIC VOLUMES
4:30-5:30 PM
AUGUST 1961
US 87 & 89
TO BELT
TENTH AVE. SOUTH
FIFTH AVE. SOUTH
THIRD AVE. SOUTH
U.S. 87 & U.S. 89 BYPASS
FIFTY SECOND STREET
FORTY THIRD STREET
THIRTY EIGHTH STREET
THIRTY SECOND STREET
TWENTY SIXTH STREET
TWENTY FIFTH STREET
TWENTY THIRD STREET
ELEVENTH STREET
THIRTEENTH ST.
FOURTEENTH ST.
FIFTEENTH ST.
EIGHTH AVE. NORTH
SECOND AVE. NORTH
FIRST AVE. NORTH
CENTRAL AVE.
FIRST AVE. SOUTH
SECOND AVE. SOUTH
FOURTH AVE. SOUTH
FIFTH AVE. SOUTH
TENTH AVE. SOUTH

EXHIBIT 9

GREAT FALLS URBAN TRANSPORTATION STUDY
TRAFFIC PATTERNS
1961

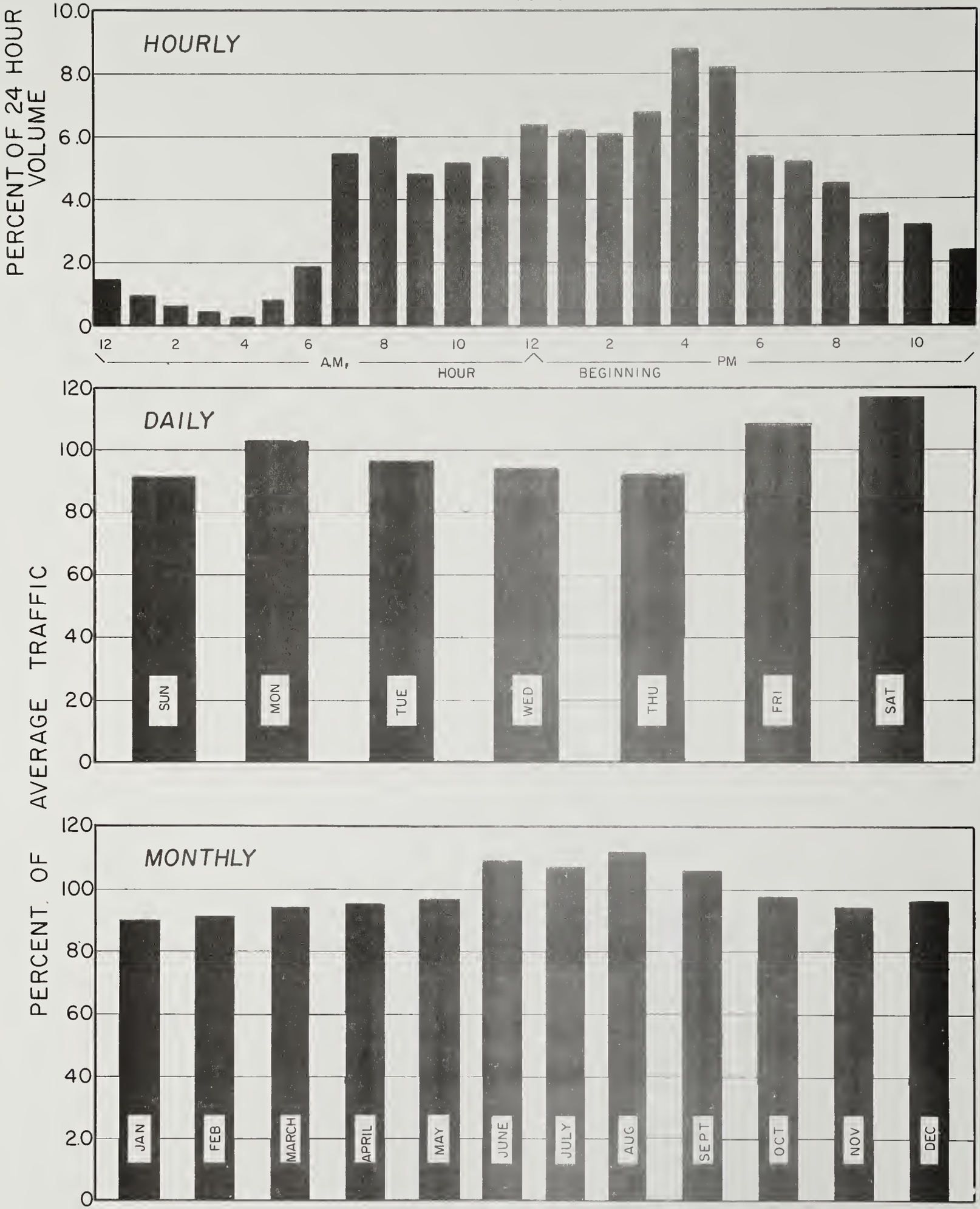


EXHIBIT 10

Business District and residential areas.

The daily traffic variation shown in Exhibit 10 on page 32, is based on traffic patterns obtained from a portable counter operated for approximately one month on Central Avenue in the Central Business District. Daily variations during an average week ranged from a high of 17 percent above average on Saturday, down to 8 percent below average on Sunday. Traffic on Friday, the highest weekday, was about 7 percent above the average day for the week.

Traffic variations by months, as shown in Exhibit 10, were obtained from a permanent traffic recorder located on 25th Street North. Monthly traffic patterns at this station ranged from a high of 13 percent above the yearly average in August, down to 11 percent below the yearly average in January. Traffic volumes recorded during May and October were about average for the year. This monthly pattern is quite typical for smaller cities in the northern states.

VEHICLE MILES OF TRAVEL

The results of a special vehicle-mile travel study indicate that about 363,000 vehicles miles of travel are generated each day on the roads and streets within the Great Falls study area. The average 24 hour traffic volume amounted to 1,538 vehicles on all roads and streets within the survey area on an average weekday in 1961. Each resident of the study area traveled an average of 4.9 miles on an average weekday.

These vehicle-mile data were obtained by computing the distance between each zone centroid and multiplying this distance by the number of trips between each zone as obtained in the origin and destination surveys. All computations were made by means of an IBM computer. The average weekday traffic volume (1,538) on all roads and streets was obtained by dividing the total number of vehicle miles generated between zones (363,000) by the total miles

(236) of roads and streets within the area. Vehicle-miles traveled per resident were obtained by dividing the total vehicle-miles generated in the area (363,000) by the estimated number of residents in 1961 (74,735).

The Quality of Traffic Service

THE QUALITY OF TRAFFIC SERVICE

The quality of service that a street system provides may be measured by such factors as average driving speeds, average vehicle delay rates, intersection traffic capacities, and accident experience. All of these factors were examined to determine the present deficiencies on the major street network of Great Falls. Present deficiencies must be located and analyzed before any corrective measures can be proposed.

Certain standards of operation for various types of streets have been adopted by The National Committee on Urban Transportation. These standards of speed, overall travel time, and safety have been used, with some local modifications, to evaluate the present major street network in Great Falls.

AVERAGE DRIVING SPEEDS

Most automobile drivers measure the desirability of a route in terms of the total travel time involved in reaching their destination. Thus, the factor of travel time must be given a great deal of weight in evaluating the traffic-carrying capacities of a major street system.

Travel time studies were made in Great Falls on all sections of the major street system. Control points were established at the intersections of major streets and timed runs were conducted between control points by the "Average Speed" method. By this method, the driver of the survey car keeps the vehicle in the traffic stream and attempts to maintain the average speed by passing about the same number of vehicles that passed him. An observer in the survey car recorded the elapsed time between control points and the location, cause and duration of any standing delays encountered on the control section.

A minimum of six runs were made over each control section during the peak hour in the direction of the predominant flow of traffic. After six

runs were completed, a check for deviation from the average travel time was made. If this check indicated that all times were not within acceptable limits of the average time, additional runs were made.

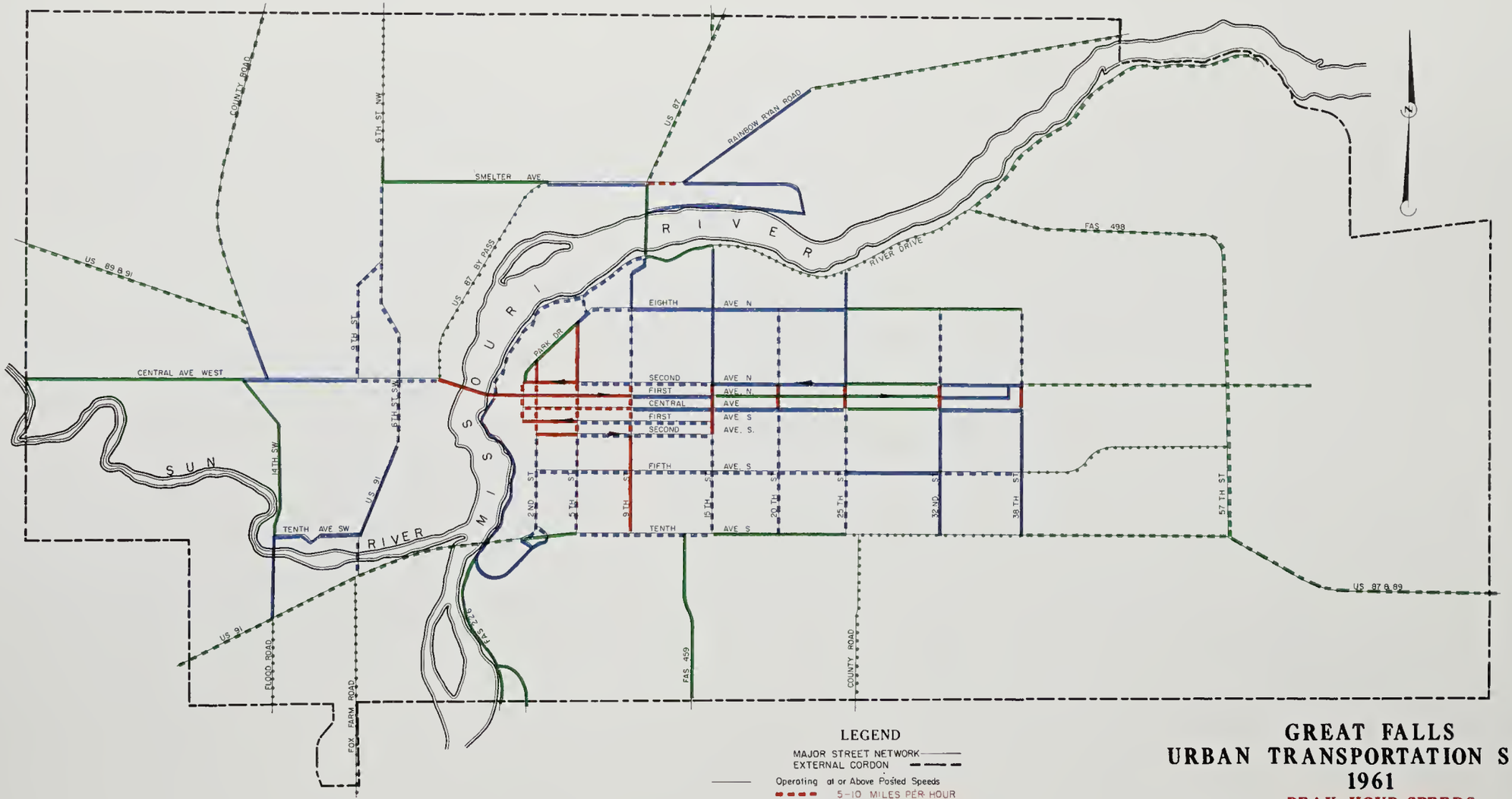
A minimum of three runs were also made over each section during off-peak hours to determine how fast the traffic was moving when congestion was at a minimum.

Exhibit 11 on page 38 illustrates the average speeds that were attained during the peak hour on the major street system in Great Falls. Areas of intense congestion become quite apparent on those sections of streets where the indicated speed drops below 10 miles per hour. As might be expected, the lowest speeds recorded during the peak hour of travel were on arterials in or near the Central Business District. Speeds on Central Avenue between Park Drive and Ninth Street dropped to about 8 miles per hour during the evening rush hour between 4:30 p.m. and 5:30 p.m.. Other low speed, congested sections were found on Park Drive between Second Avenue North and First Avenue South, Smelter Avenue between U.S. 87 and Rainbow-Ryan Road, and Ninth Street between Second Avenue North and First Avenue South. Speeds on all of these sections were below 10 miles per hour during the peak hour.

AVERAGE DELAY RATES

Exhibit 12 on page 39 illustrates the average delay rate per vehicle that was encountered during the evening peak hour on the major street system in Great Falls. The delay rates, as shown in this exhibit, were computed by converting the average speeds obtained during the peak hour to an actual rate of vehicle motion expressed as the number of minutes required to travel one mile under existing conditions. The actual rate of motion thus obtained was then subtracted from the recommended standard or optimum rate of motion for

EXHIBIT 11



LEGEND

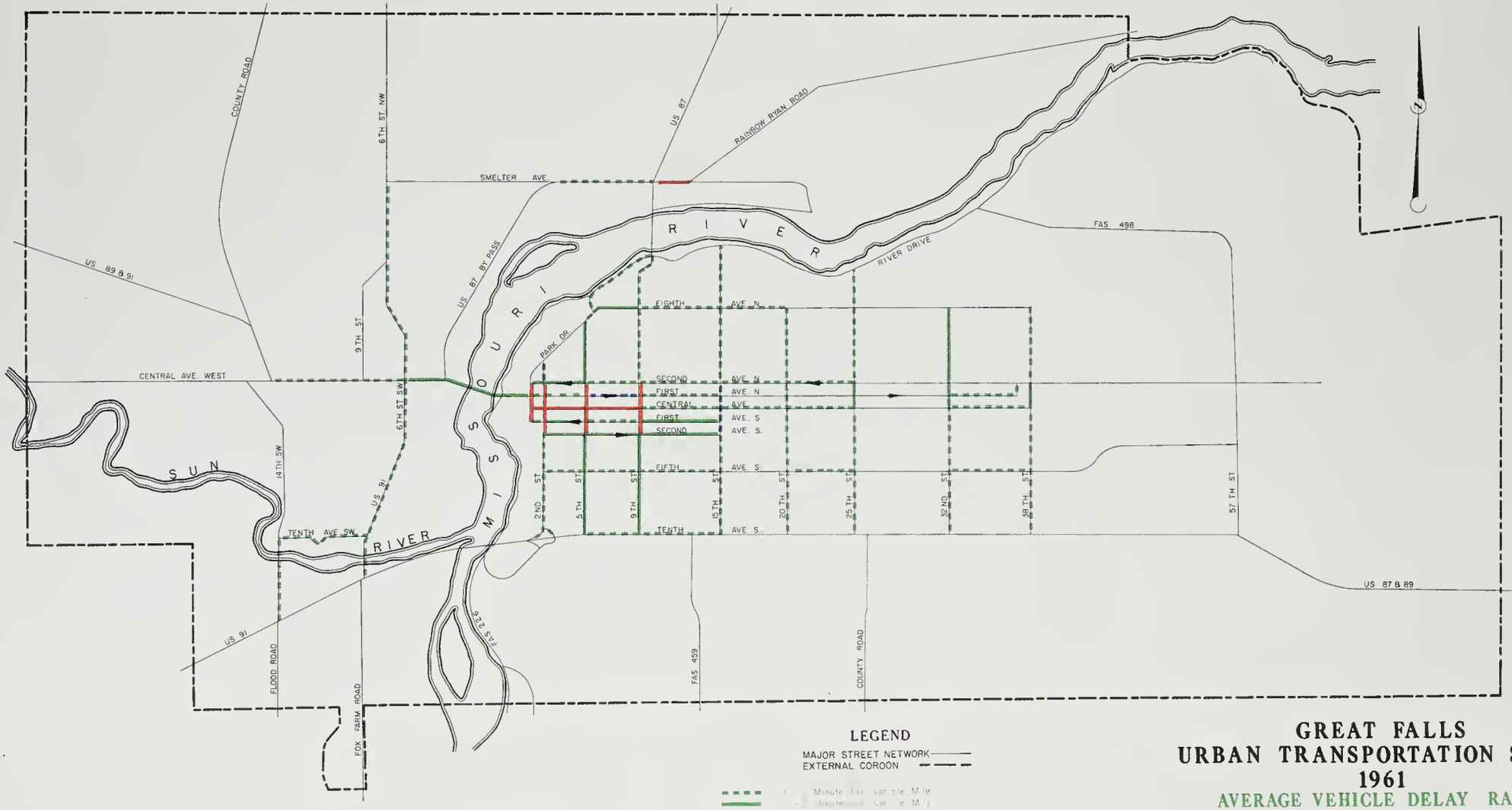
MAJOR STREET NETWORK
EXTERNAL CORDON

Operating at or Above Posted Speeds

- 5-10 MILES PER HOUR
- 11-15 MILES PER HOUR
- 16-20 MILES PER HOUR
- 21-25 MILES PER HOUR
- 26-30 MILES PER HOUR
- 31-35 MILES PER HOUR
- 36-45 MILES PER HOUR
- OVER 45 MPH

GREAT FALLS
URBAN TRANSPORTATION STUDY
1961
PEAK HOUR SPEEDS
4:30 PM - 5:30 PM

EXHIBIT 12



LEGEND

MAJOR STREET NETWORK
EXTERNAL CORDON

Minute Per Vehicle Mile
Minutes Per Vehicle Mile
2 - 3 Minutes Per Vehicle Mile
3 - 4 Minutes Per Vehicle Mile
Over 4 Minutes Per Vehicle Mile

GREAT FALLS URBAN TRANSPORTATION STUDY 1961

AVERAGE VEHICLE DELAY RATE PEAK HOUR

the section. The resulting difference between the actual rate and the standard rate of motion is the vehicle delay rate expressed as the number of minutes per mile that each vehicle is excessively delayed.

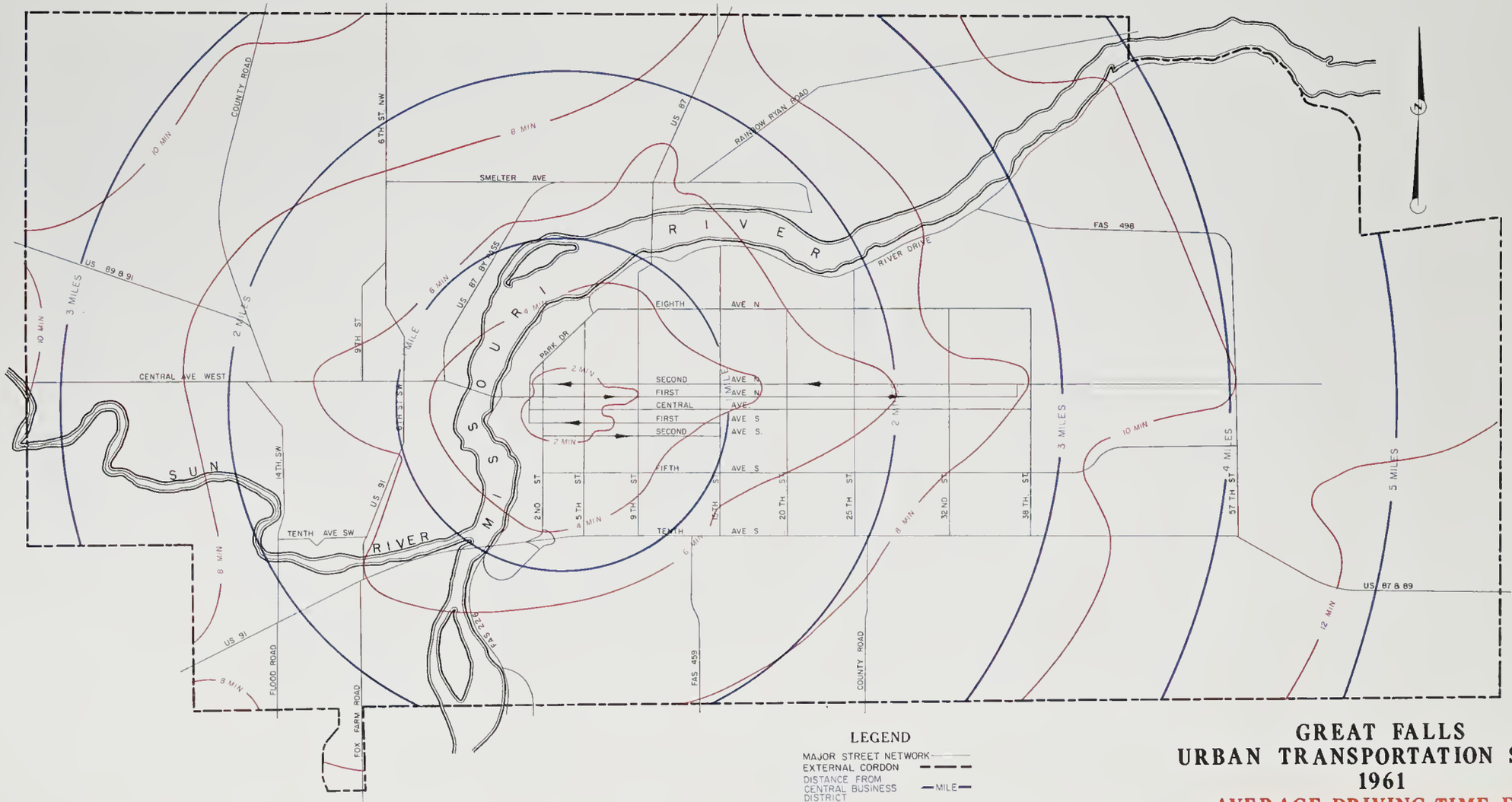
The standard rates of motion used for this study were 2.4 minutes per mile (25 MPH) on major arterials and 3.0 minutes per mile (20 MPH) on streets classified as collectors. These standards are suggested by The National Committee on Urban Transportation in their procedure manual for travel time studies.

Central Avenue between Park Drive and Ninth Street may be used as an example of total time lost during the peak hour due to excessive delay. The length of this control section is 0.66 miles and the average volume of eastbound traffic over the section was 408 vehicles during the peak hour. At the computed delay rate of 4.50 minutes per vehicle per mile, a total of about 1,200 minutes or 20 hours were lost by all vehicles traveling east during the peak hour on this section. The monetary value of this excessive delay time now occurring each weekday amounts to a substantial sum over an extended period of time.

DRIVING TIME AND DISTANCE FROM THE CENTRAL BUSINESS DISTRICT

Average driving times to and from the center of the Central Business District of Great Falls to all other parts of the survey area are graphically illustrated in Exhibit 13 on page 41. The intersection of Fourth Street and Central Avenue has been assumed as the approximate center of the Central Business District. Driving times to all points in the survey area have been computed from this intersection. Average driving time over each section was computed by averaging the elapsed times obtained from time runs made during both the peak and off-peak hours.

EXHIBIT 13



LEGEND

- MAJOR STREET NETWORK
- EXTERNAL CORDON
- DISTANCE FROM CENTRAL BUSINESS DISTRICT — MILE —
- DRIVING 1 MI. FROM CENTRAL BUSINESS DISTRICT — MIN —

GREAT FALLS URBAN TRANSPORTATION STUDY 1961

AVERAGE DRIVING TIME FROM CENTRAL BUSINESS DISTRICT

This exhibit indicates that virtually all parts of the survey area are within a maximum of 12 minutes driving time of the Central Business District. Trips from the Central Business District to the eastern part of the city have a slight time advantage over those trips destined west of the Missouri River. This can be attributed to relatively more congestion and lower speeds encountered on Central Avenue West.

TRAFFIC CAPACITIES OF SIGNALIZED INTERSECTIONS

The practical traffic capacity of an intersection is defined in the Highway Capacity Manual as "the maximum traffic volume that can enter the intersection from that approach during one hour with most of the drivers being able to clear the intersection without waiting for more than one signal cycle". The possible or absolute traffic capacity of an intersection is about 20 percent greater than the practical capacity. Under possible traffic capacity conditions, motorists tend to form long queues while waiting to enter the intersection, and there will be a continual backlog of waiting vehicles during each signal cycle. The possible capacity of an intersection therefore usually represents intolerable conditions due to the long waits experienced by a high percentage of the motorists. Practical traffic capacity on the other hand may be used as a realistic traffic volume for future design.

Some of the more important factors that affect intersection capacity are listed as follows:

1. Width of street
2. Length of green-time allocated to each approach
3. One-way or two-way traffic flow
4. Percent of commercial vehicles
5. Percent of right and left turns

6. Parking or no parking and the location of bus stops near the intersection

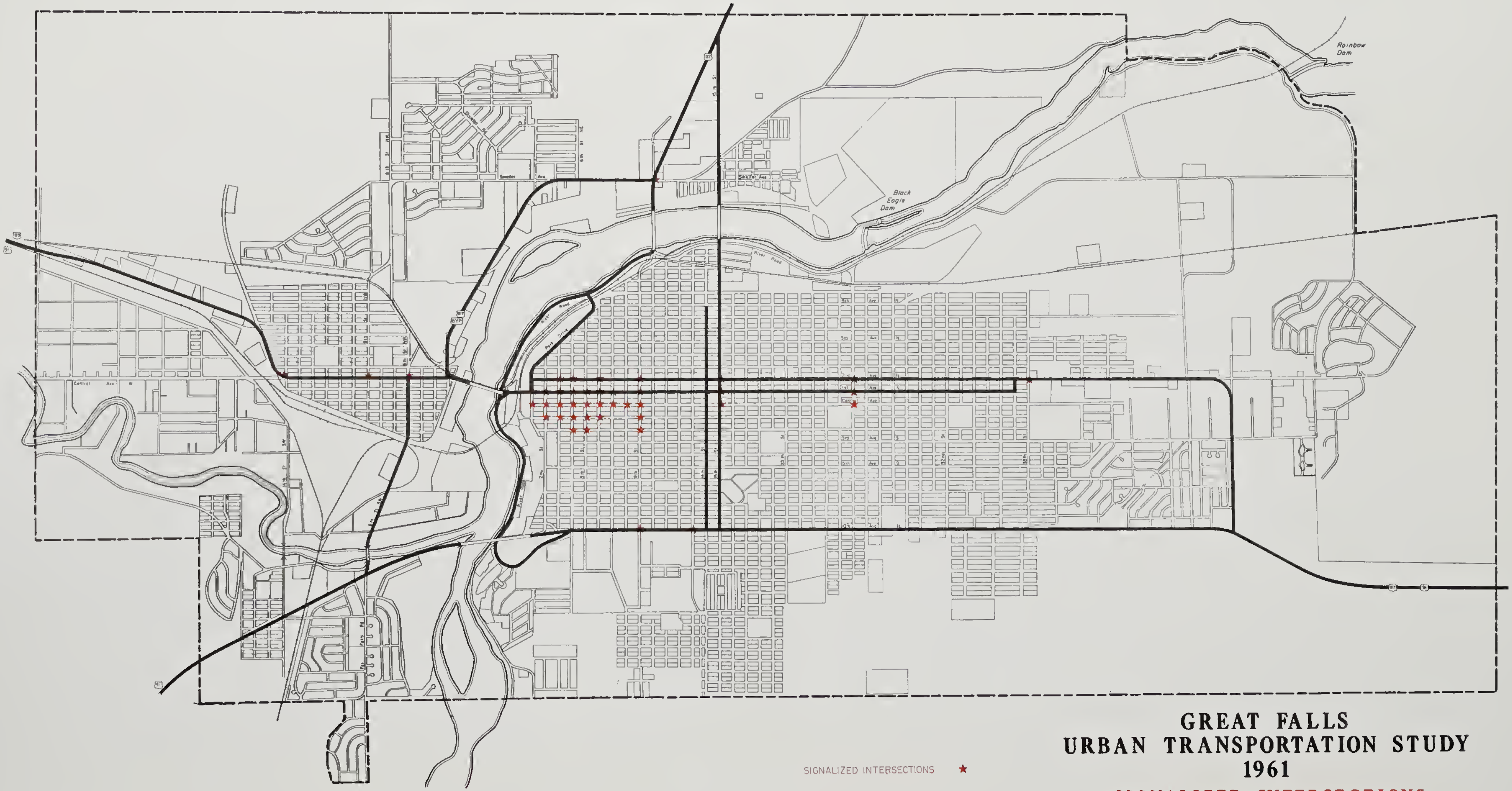
7. Amount of pedestrian interference

All of the above listed factors have been assigned weighted values in the capacity manual according to the effect each has on the overall capacity of an intersection. These values are then used in a standard formula to compute traffic capacity.

Exhibit 14 on page 44 shows the location of 45 signalized intersections in Great Falls on which the practical traffic capacity has been computed. The practical traffic capacity of each approach to these intersections, as well as the present peak-hour traffic volumes entering the intersection, are shown by means of a schematic diagram in Exhibit 15 on page 45. Intersection approaches operating at or above practical traffic capacity are denoted by a star.

The following intersection approaches were operating at or above practical traffic capacity. They are listed in descending order according to the percentage disparity between practical capacities and actual peak-hour traffic volumes.

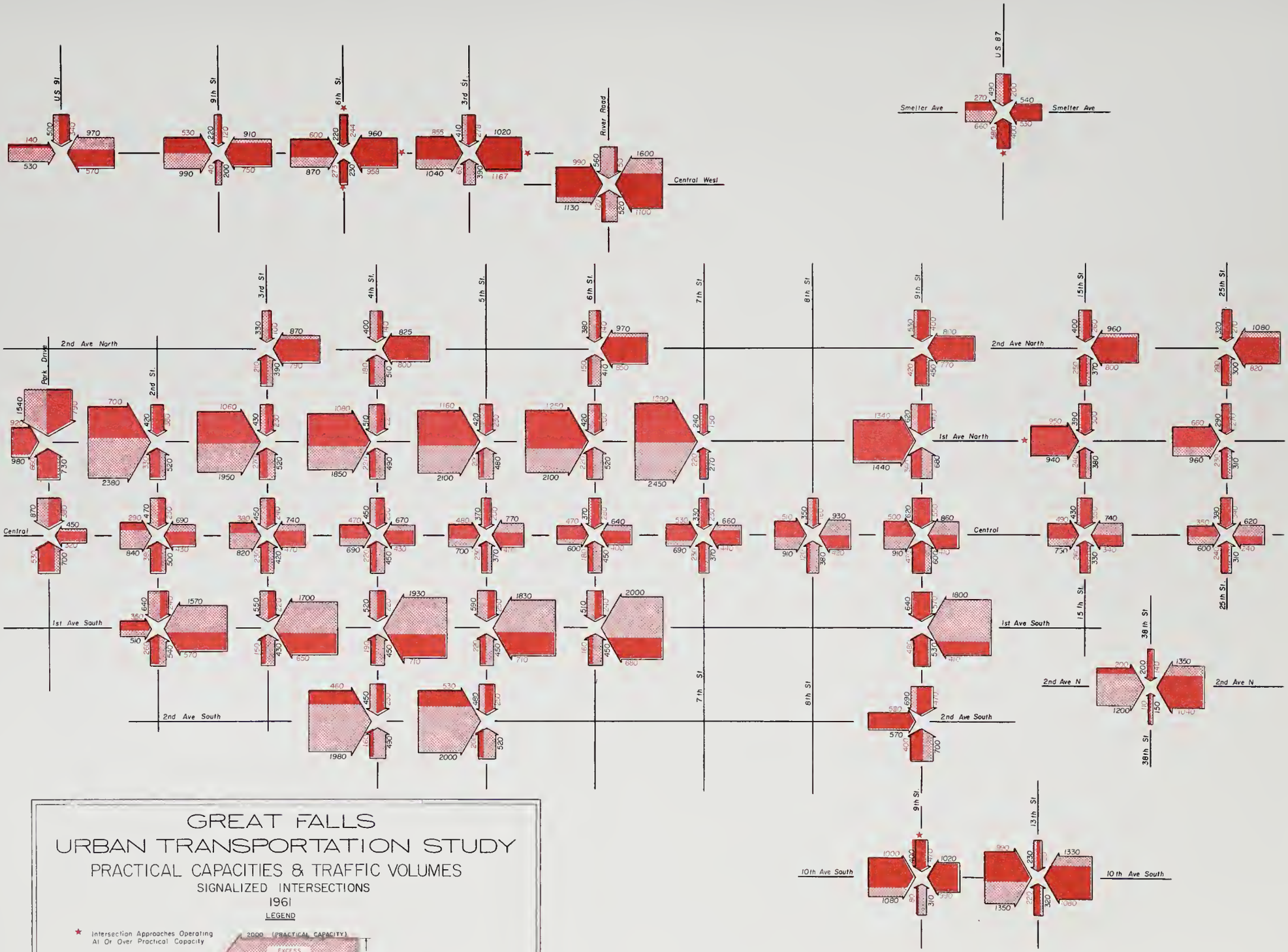
Intersection	Approach	Practical Capacity	Peak-Hour Volume	Percent of Practical Capacity
Smelter Ave. - U.S. 87	South	400	580	145
Central Ave. W. - 6th St.	South	230	273	119
10th Ave. S. - 9th St.	North	400	470	117
Central Ave. W. - 3rd St.	East	1,040	1,167	112
Central Ave. W. - 6th St.	North	220	244	111
1st Ave. N. - 15th St.	West	940	950	101
Central Ave. W. - 6th St.	East	960	958	100



GREAT FALLS
URBAN TRANSPORTATION STUDY
1961

SIGNALIZED INTERSECTIONS

EXHIBIT 14



GREAT FALLS
URBAN TRANSPORTATION STUDY
PRACTICAL CAPACITIES & TRAFFIC VOLUMES
SIGNALIZED INTERSECTIONS
1961

LEGEND

★ Intersection Approaches Operating At Or Over Practical Capacity

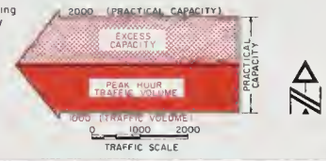


EXHIBIT 15

Approaches to the following street intersections were operating at 90 percent or more of practical traffic capacity.

Intersection	Approach	Practical Capacity	Peak-Hour Volume	Percent of Practical Capacity
Smelter Ave. - U.S. 87	East	540	530	98
10th Ave. S. - 9th St.	East	1,020	990	97
2nd Ave. N. - 4th St.	East	825	800	97
2nd Ave. N. - 9th St.	East	800	770	96
1st Ave. N. - Park Drive	West	980	920	94
1st Ave. N. - 9th St.	West	1,440	1,340	93
2nd Ave. N. - 9th St.	South	450	420	93
10th Ave. S. - 9th St.	West	1,080	1,000	93
2nd Ave. N. - 3rd St.	East	870	790	91
1st Ave. N. - Park Drive	South	730	660	90

Bridge Capacities

Capacity studies were also made on the three bridges crossing the Missouri River on 10th Avenue South, First Avenue North, and 10th Street. Factors that were considered in these studies were average speeds, number of lanes, lane width, percent of commercial vehicles, and lateral clearance to the nearest horizontal obstruction.

The results of these bridge capacity studies are tabulated as follows:

Bridge	No. of Lanes	Width of Each Lane	Percent Commercial	Peak-Hour Volume	Traffic Capacity	
					Practical	Possible
10th Ave. S.	2	14.0'	4.7	1,208 1/	1,160	1,630
1st Ave. N.	4	10.5'	5.0	1,058 2/	2,390	3,180
10th Street	2	15.0'	6.4	1,121 1/	1,220	1,690

1/ Traffic and capacity in both directions
2/ Traffic and capacity in direction of heaviest flow

As indicated in the above tabulation, the 10th Avenue South bridge was operating slightly above practical traffic capacity in 1961. Four-lane traffic on 10th Avenue South is forced to converge to two lanes at both the east and west approaches to the structure. As a result of this forced traffic convergence, a considerable amount of congestion exists at each approach to this comparatively long structure.

The bridge over the Missouri River on First Avenue North was operating well below practical traffic capacity. Traffic volumes over this structure are controlled by the number of vehicles that are able to clear the signalized intersections at First Avenue North and River Drive and Central Avenue West and Third Street. As the east approach to the Central Avenue West and Third Street intersection was operating slightly above practical traffic capacity, westbound vehicles were not able to clear the bridge during the evening peak hour.

The 10th Street bridge was operating at about 92 percent of practical traffic capacity. A new four-lane structure at 15th Street was under construction at the time of the survey and is now open to traffic. This structure should relieve some of the congestion on the 10th Street bridge.

TRAFFIC ACCIDENTS

Another important criterion of how well a particular street or network functions is the frequency of traffic accidents experienced over a period of years. A higher than normal accident frequency rate is usually an indication that a particular street section is not carrying its traffic load in a satisfactory manner.

A study has been made of all reported accidents on the selected major street network in Great Falls for the 3-year period of 1960-1962. The accident records of both the Great Falls Police Department and the Montana

Highway Patrol were used to compile and classify all accidents for the three-year period. Each accident was located and assigned to one of the 115 control sections on the major street network. Collision diagrams were also prepared to illustrate the 10 street intersections that had the highest number of accidents during the 3-year period.

The following table compares the number and type of accidents that occurred on all streets and highways in the study area with the number and type that occurred on the major street network.

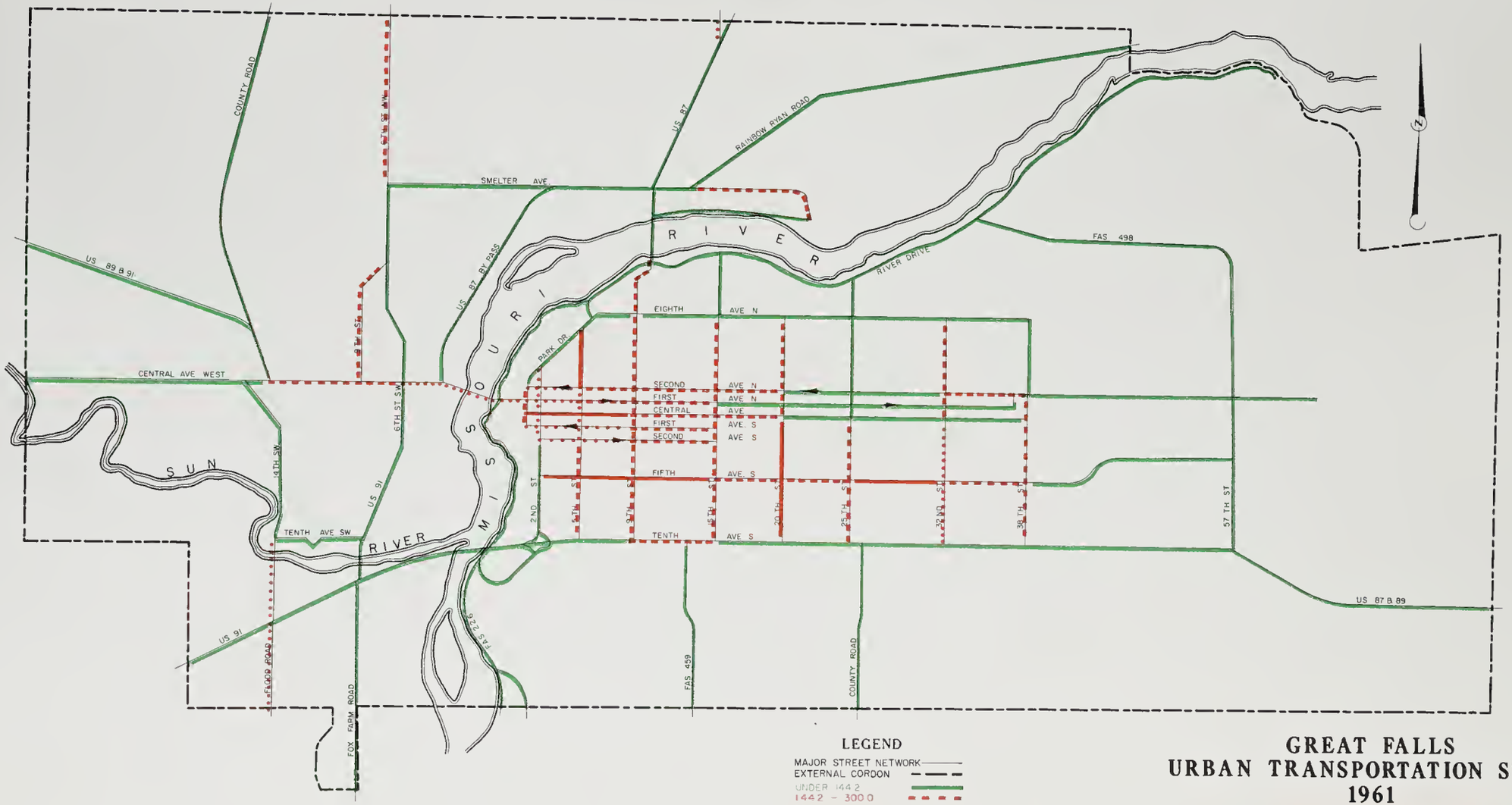
	ALL STREETS & HIGHWAYS			MAJOR STREET NETWORK			
	Type of Accident			Type of Accident			PERCENT OF
YEAR	Fatal	Injury	Total	Fatal	Injury	Total	ALL ACCIDENTS
1960	4	108	2,257	4	81	1,565	69.3
1961	7	114	2,323	6	79	1,656	71.3
1962	9	135	2,619	7	82	1,820	69.5
TOTAL	20	357	7,199	17	242	5,041	70.0

As indicated in the above tabulation, about 70% of all reported accidents in the study area occurred on the selected major street network. This network includes approximately 77 miles of streets and highways and represents 33% of the total mileage within the survey area.

Accident Rates

The relative level of accident hazard on a particular street section becomes more realistic when the number of accidents is weighted by the amount of travel over the section. The accident rate, as shown in Exhibit 16 on page 49, has therefore been computed to indicate the number of accidents that have occurred on each control section during a 3-year period for each 10 million vehicle miles of driving. The formula used in these computations is as shown on page 50.

EXHIBIT 16



LEGEND

MAJOR STREET NETWORK
EXTERNAL CORDON
UNDER 1442
1442 - 3000
3001 - 5000
OVER 5000
AVERAGE 1442

GREAT FALLS URBAN TRANSPORTATION STUDY

1961

ALL ACCIDENT RATE
PER 10 MILLION VEHICLE MILES
THREE YEAR PERIOD
1960-1962

$$R = \frac{A \times 10{,}000{,}000}{S \times Y \times 3(365)}$$

Where: R = Accident rate per 10,000,000 vehicle miles

A = Total number of accidents occurring on control section during 3-year period

S = Length of control section in miles

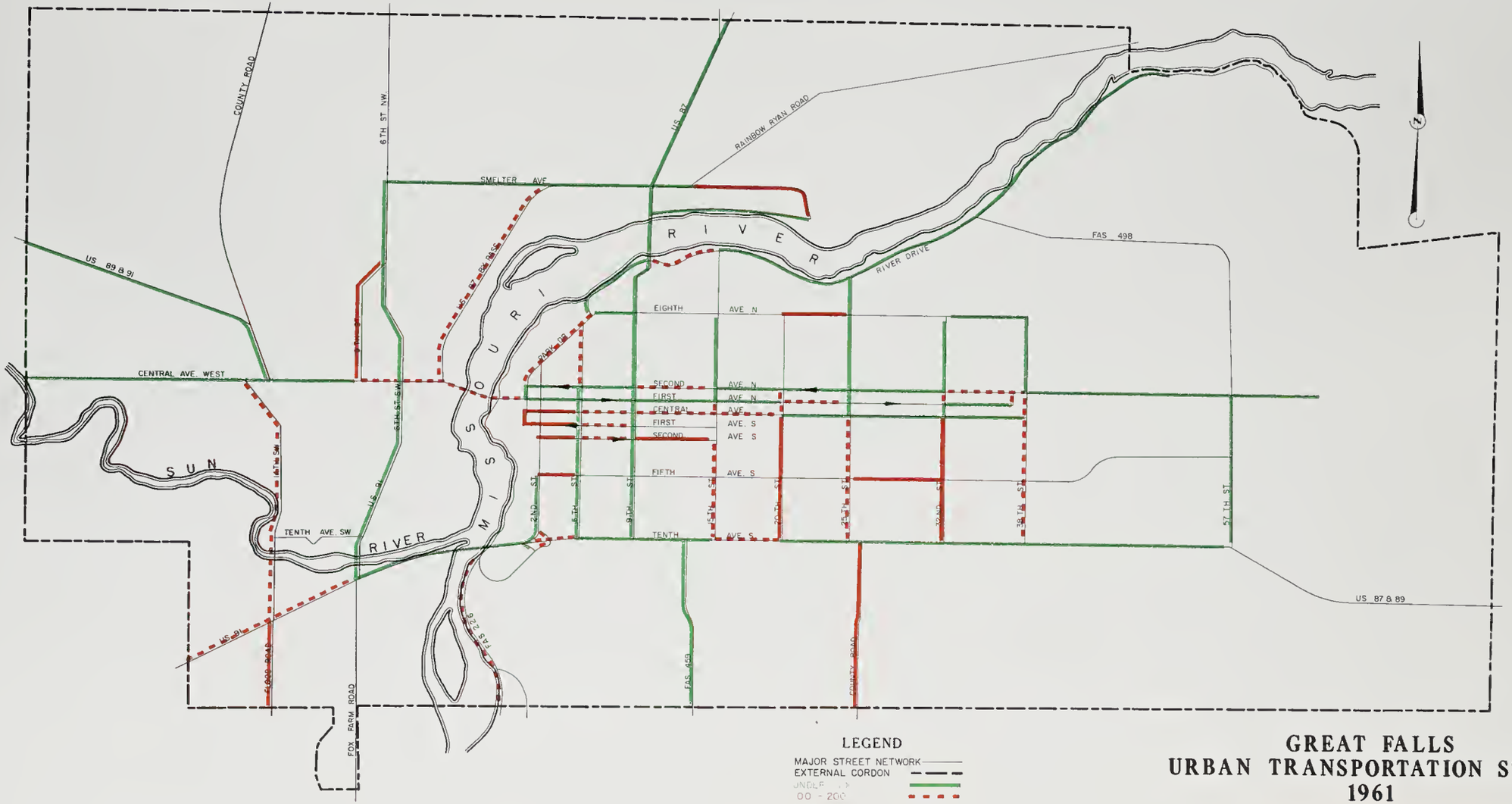
Y = Average daily traffic over control section for 3-year period

The average rate for all accidents on the major street network was 144.2 per 10 million vehicle miles of travel for the 3-year period of 1960-1962. Rates above and below this network average are illustrated by means of colored bands in Exhibit 16 on page 49. Approximately 24 miles of streets or 31% of the network had an accident rate of over 144.2 per 10 million vehicle miles of travel. Fifth Avenue South, a two-lane collector street now carrying comparatively low traffic volumes of from 400 to 1500 vehicles per day, had accident rates of over 500 per 10 million vehicle miles of travel from Second Street to 15th Street and from 25th Street to 32nd Street. On the other hand, 10th Avenue South, a four-lane divided arterial, was carrying traffic volumes of from 6,000 to 22,500 vehicles per day with below-average accident rates throughout with the exception of one short section between Ninth Street and 15th Street.

Some measure of accident severity may be obtained by relating the number of fatal and nonfatal injuries to vehicle miles of travel during a specified period of time. In this study, the criterion of 100 million vehicle miles of travel was used to compute the injury rate in the same formula that was used for all accidents. The results of this study are shown in Exhibit 17 on page 51.

The desirable minimum injury accident rates per 100 million vehicle miles

EXHIBIT 17



LEGEND

MAJOR STREET NETWORK
EXTERNAL CORDON
UNDER 100
100 - 200
OVER 200

Note
Sections with no recorded injuries are not colored

GREAT FALLS URBAN TRANSPORTATION STUDY 1961

INJURY ACCIDENT RATES PER 100 MILLION VEHICLE MILES

of travel, as recommended by The National Committee On Urban Transportation, are as follows:

Type of Street	Accident Rate	
	Fatal	Injury*
Major Arterial-Divided	2.0-5.0	75-150
Major Arterial-Undivided	3.0-6.0	100-200
Collector	2.0-4.0	60- 80

* Includes fatal and nonfatal injuries

The injury accident rate for the 3-year period 1960-1962 on the entire major network in Great Falls was 68.9 per 100 million vehicle miles of travel, which is well within the norms established by The National Committee On Urban Transportation. The fatality rate for the same 3-year period on the entire system was 5.1 per 100 million vehicle miles of travel, which is again comparable to the normal ranges of fatality rates established by the Committee.

Control sections having injury accident rates above 200 per 100 million vehicle miles of travel are shown by a solid red band in Exhibit 17 on page 51. These sections that had above normal injury accident rates during the 3-year period of 1960-1962, total 7.4 miles and represent about 10% of the total major street network mileage.

COLLISION DIAGRAMS

The intersection collision diagrams, shown in Exhibits 18 to 27 on pages 55 to 64, illustrate the manner in which accidents occurred at the ten intersections that had the greatest number of accidents during the 3-year period of 1960-1962. Accidents at each intersection are illustrated by standard symbols and are summarized by type in the lower left corner of each diagram.

The intersection having the highest number of accidents was Central Avenue West and Third Street, which had a total of 99 accidents during the 3-year period of 1960-1962. Central Avenue West and Sixth Street was second highest with a total of 89 accidents during the same 3-year period of survey.

The following tabulation lists the ten critical intersections in descending order by the number of accidents occurring at each during the 3-year period.

Rank	Intersection	No. of Accidents
1	Central Avenue West and Third Street	99
2	Central Avenue West and Sixth Street	89
3	10th Avenue South and Ninth Street	77
4	Central Avenue and Sixth Street	65
5	First Avenue North and River Drive	64
6	First Avenue North and Park Drive	59
7	10th Avenue South and 13th Street	58
8	Central Avenue and Park Drive	52
9	Central Avenue and Fourth Street	52
10	Central Avenue West and Ninth Street	52
	TOTAL	667

The intersections that are ranked 1, 2, and 3 in the above tabulation were found to be operating at above practical traffic capacity. Intersection number 6 was operating within 10% of practical traffic capacity. Total accidents occurring at these ten intersections (667) amounted to about 9% of the total accidents occurring in the area (7,199) during the 3-year period 1960-1962.

The following tabulation summarizes all accidents occurring at the ten intersections during the 3-year period 1960-1962 by collision type and severity.

Collision Type	Fatal	Injury	Property Damage Only	Total	Percent
Angle		1	78	79	11.9
Head-On		1	4	5	0.8
Rear-End		8	347	355	53.2
Sideswipe		2	55	57	8.5
Turning Movement		2	126	128	19.2
Parking			3	3	0.4
Noncollision					
Fixed Object	1	2	21	24	3.6
Pedestrian		8		8	1.2
Backing			4	4	0.6
Miscellaneous		1	3	4	0.6
TOTAL	1	25	641	667	100.0

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT
ACCIDENT ANALYSIS

COLLISION DIAGRAM

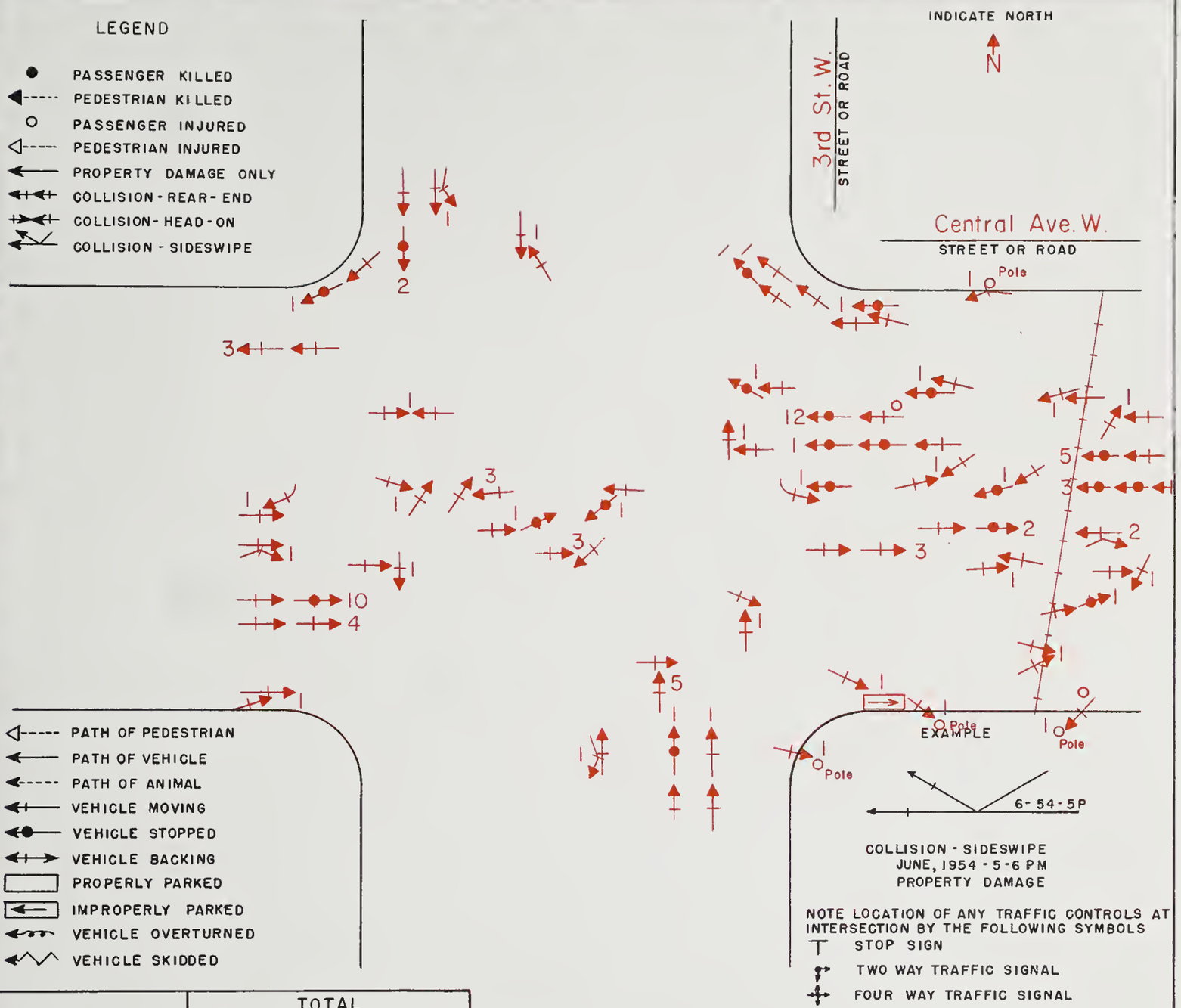
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF Central Ave. W AND 3 St. W.

HIGHWAY NUMBER

PERIOD COVERED 1960 1961 1962

COMPILED BY DRAWN BY DATE



COLLISION - SIDESWIPE
JUNE, 1954 - 5-6 PM
PROPERTY DAMAGE

NOTE LOCATION OF ANY TRAFFIC CONTROLS AT INTERSECTION BY THE FOLLOWING SYMBOLS

- STOP SIGN
- TWO WAY TRAFFIC SIGNAL
- FOUR WAY TRAFFIC SIGNAL

COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			24	24
HEAD - ON			2	2
REAR - END		1	47	48
SIDESWIPE			5	5
TURNING MOVEMENT			16	16
PARKING				
NON - COLLISION				
FIXED OBJECT		1	3	4
PEDESTRIAN				
BACKING				
MISC.				
TOTAL		2	97	99

REMARKS

EXHIBIT 18

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT

ACCIDENT ANALYSIS

COLLISION DIAGRAM

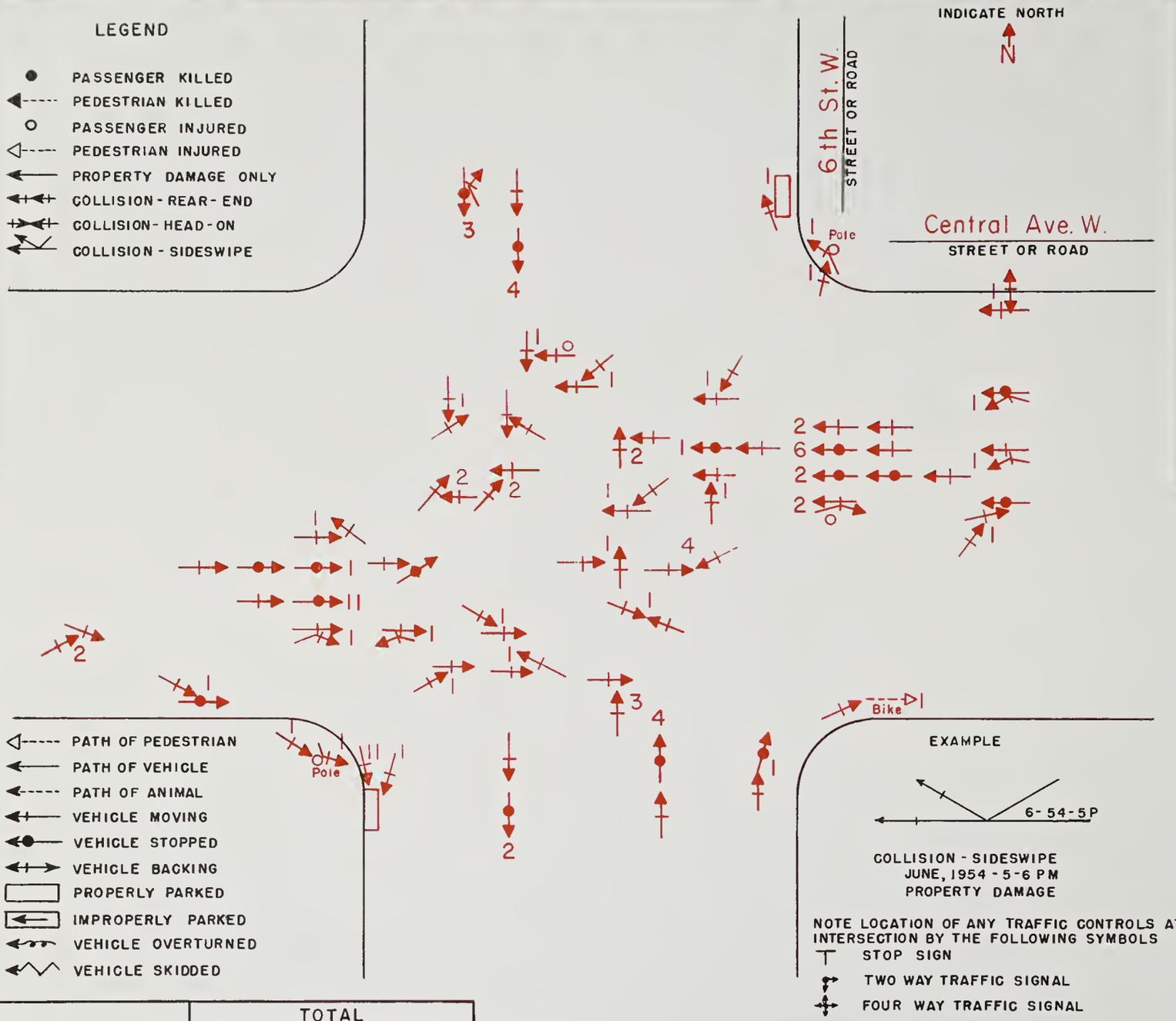
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF Central Ave. W. AND 6th St. W

HIGHWAY NUMBER _____

PERIOD COVERED 1960 1961 1962

COMPILED BY _____ DRAWN BY _____ DATE _____



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE		1	12	13
HEAD - ON				
REAR - END			35	35
SIDESWIPE		1	6	7
TURNING MOVEMENT			28	28
PARKING				
NON - COLLISION				
FIXED OBJECT			4	4
PEDESTRIAN				
BACKING			1	1
MISC.			1	1
TOTAL		2	87	89

REMARKS _____

EXHIBIT 19

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT

ACCIDENT ANALYSIS

COLLISION DIAGRAM

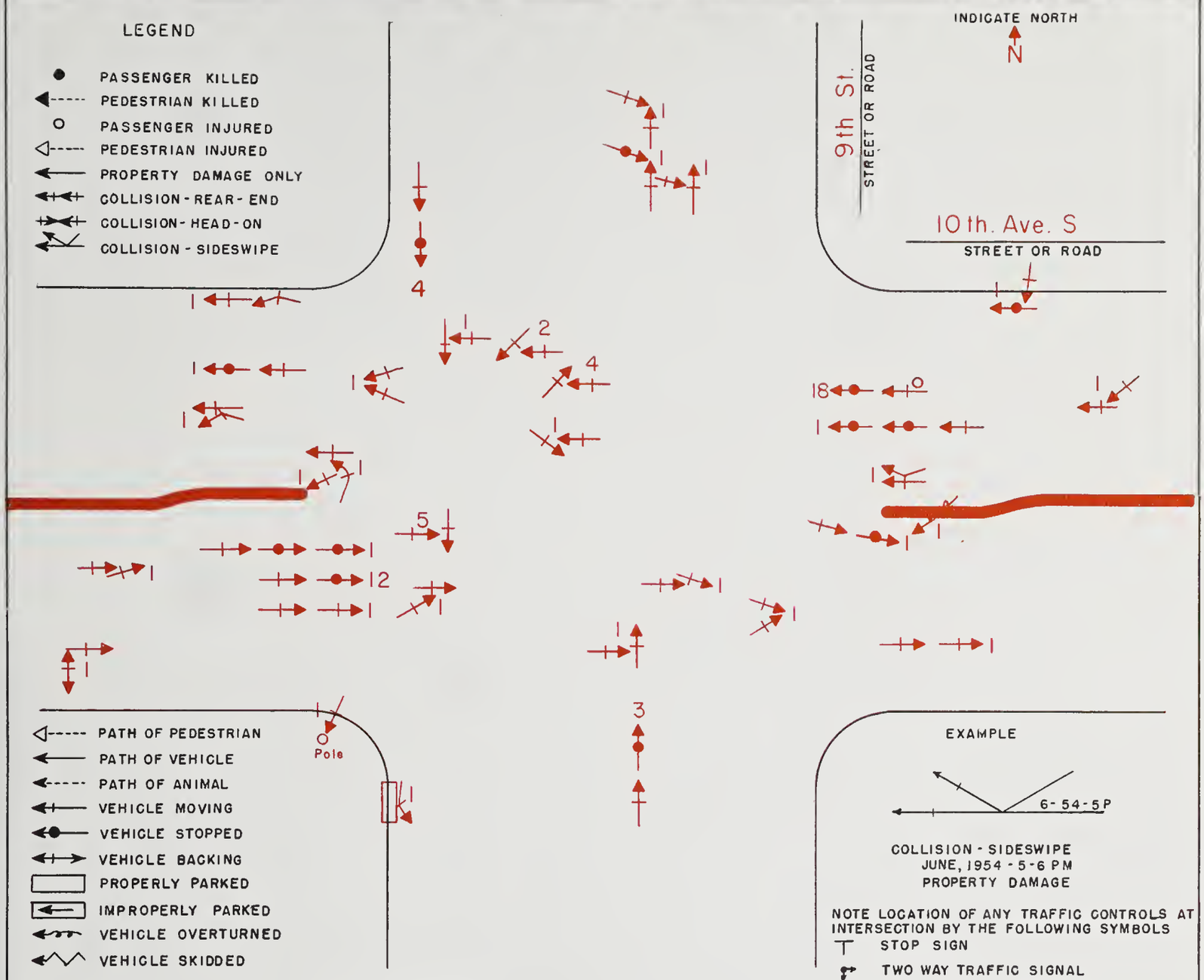
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF 10th Ave. S. AND 9th. St.

HIGHWAY NUMBER

PERIOD COVERED 1960 1961 1962

COMPILED BY DRAWN BY DATE



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			15	15
HEAD - ON				
REAR - END		1	41	42
SIDESWIPE			3	3
TURNING MOVEMENT			12	12
PARKING			1	1
NON - COLLISION				
FIXED OBJECT			3	3
PEDESTRIAN				
BACKING			1	1
MISC.				
TOTAL		1	76	77

REMARKS

EXHIBIT 20

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT

ACCIDENT ANALYSIS

COLLISION DIAGRAM

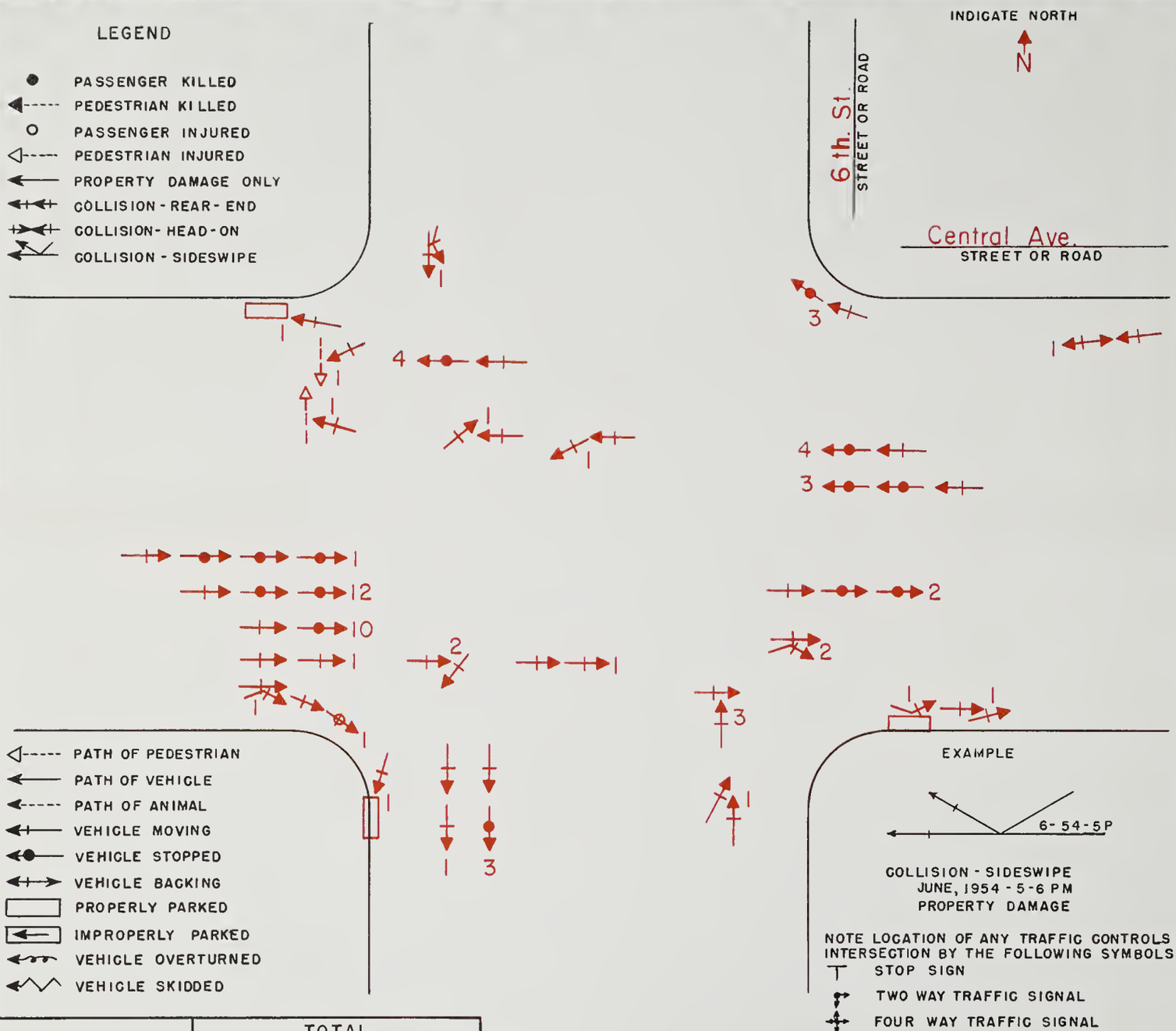
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF Central Ave. AND 6th. St.

HIGHWAY NUMBER _____

PERIOD COVERED 1960 1961 1962

COMPILED BY _____ DRAWN BY _____ DATE _____



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			3	3
HEAD - ON				
REAR - END			43	43
SIDESWIPE			5	5
TURNING MOVEMENT			9	9
PARKING			2	2
NON - COLLISION				
FIXED OBJECT				
PEDESTRIAN		2		2
BACKING		1	1	1
MISC.				
TOTAL		2	63	65

REMARKS _____

EXHIBIT 21

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT

ACCIDENT ANALYSIS

COLLISION DIAGRAM

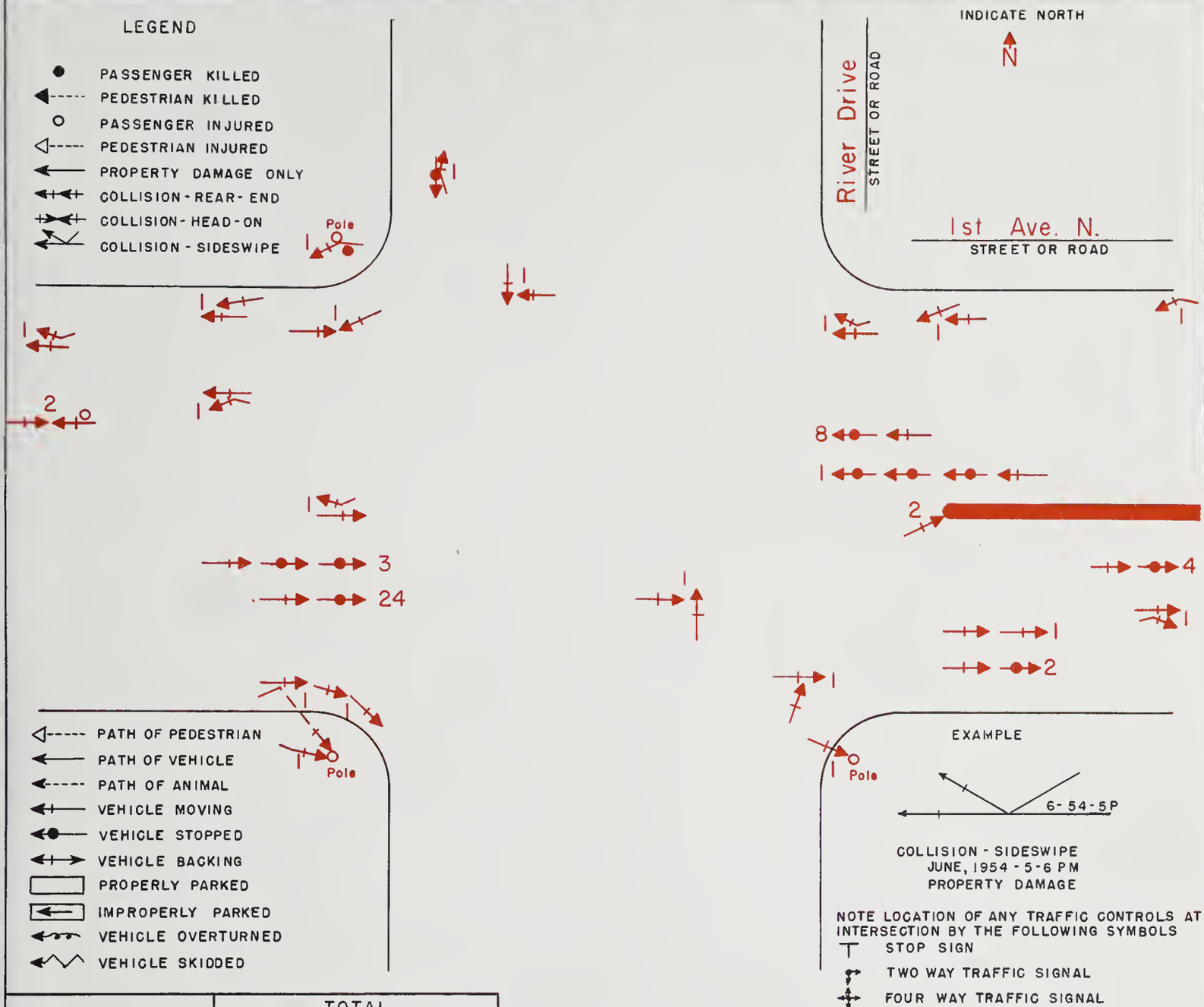
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF 1st Ave. N. AND River Drive

HIGHWAY NUMBER _____

PERIOD COVERED 1960 1961 1962

COMPILED BY _____ DRAWN BY _____ DATE _____



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE				
HEAD - ON			4	4
REAR - END		1	2	3
SIDESWIPE			43	43
TURNING MOVEMENT			6	6
PARKING			2	2
NON - COLLISION				
FIXED OBJECT	1		5	6
PEDESTRIAN				
BACKING				
MISC.				
TOTAL	1	1	62	64

REMARKS _____

EXHIBIT 22

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT

ACCIDENT ANALYSIS

COLLISION DIAGRAM

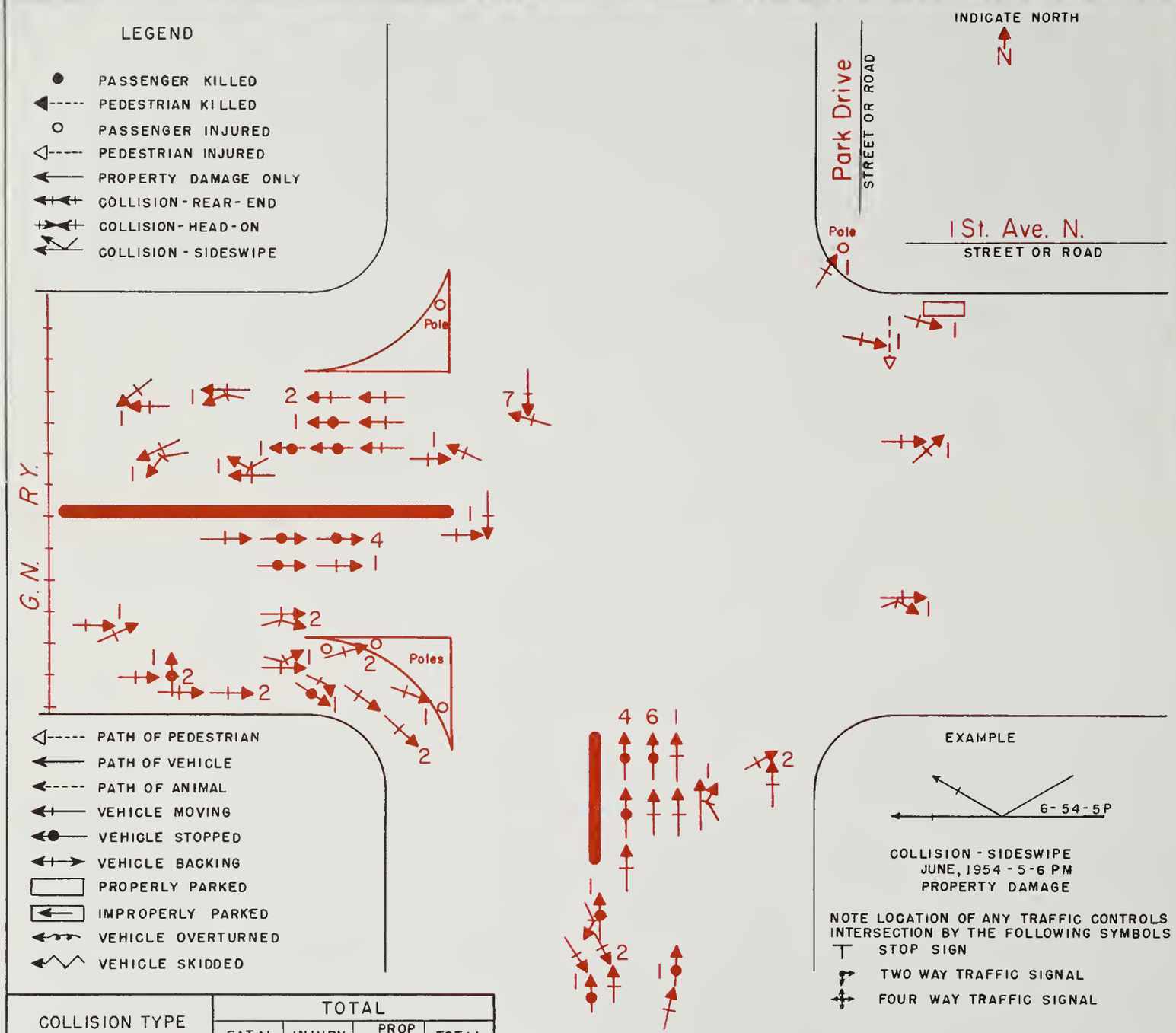
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF 1St Ave. N. AND Park Drive

HIGHWAY NUMBER

PERIOD COVERED 1960 1961 1962

COMPILED BY DRAWN BY DATE



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			6	6
HEAD - ON				
REAR - END			21	21
SIDESWIPE			8	8
TURNING MOVEMENT		2	17	19
PARKING				
NON - COLLISION				
FIXED OBJECT		1	3	4
PEDESTRIAN		1		1
BACKING				
MISC.				
TOTAL		4	55	59

REMARKS

EXHIBIT 23

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT

ACCIDENT ANALYSIS

COLLISION DIAGRAM

CITY OF Great Falls COUNTY Cascade

INTERSECTION OF 10th Ave. S. AND 13th. St.

HIGHWAY NUMBER

PERIOD COVERED 1960 1961 1962

COMPILED BY DRAWN BY DATE

LEGEND

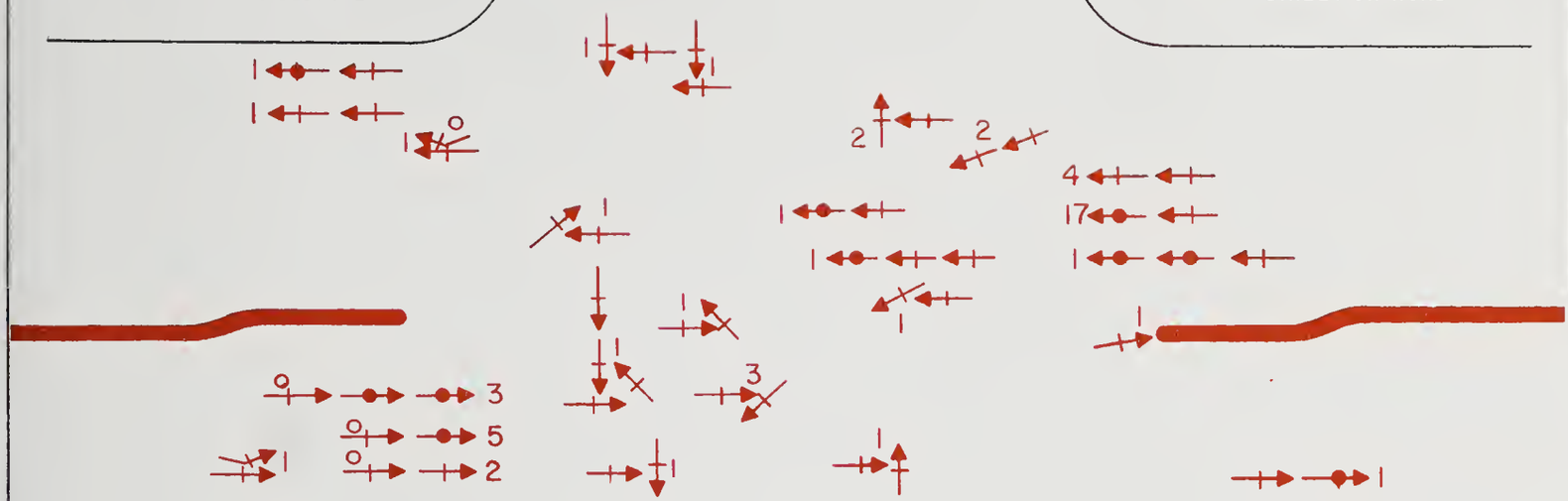
- PASSENGER KILLED
- PEDESTRIAN KILLED
- PASSENGER INJURED
- PEDESTRIAN INJURED
- PROPERTY DAMAGE ONLY
- COLLISION - REAR - END
- COLLISION - HEAD - ON
- COLLISION - SIDESWIPE

INDICATE NORTH

N

13 th. St. STREET OR ROAD

10 th. Ave. S. STREET OR ROAD



- PATH OF PEDESTRIAN
- PATH OF VEHICLE
- PATH OF ANIMAL
- VEHICLE MOVING
- VEHICLE STOPPED
- VEHICLE BACKING
- PROPERLY PARKED
- IMPROPERLY PARKED
- VEHICLE OVERTURNED
- VEHICLE SKIDDED

2

1

EXAMPLE

6-54-5P

COLLISION - SIDESWIPE
JUNE, 1954 - 5-6 PM
PROPERTY DAMAGE

NOTE LOCATION OF ANY TRAFFIC CONTROLS AT INTERSECTION BY THE FOLLOWING SYMBOLS

- STOP SIGN
- TWO WAY TRAFFIC SIGNAL
- FOUR WAY TRAFFIC SIGNAL

COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			7	7
HEAD - ON				
REAR - END		3	36	39
SIDESWIPE		1	2	3
TURNING MOVEMENT			8	8
PARKING				
NON - COLLISION				
FIXED OBJECT			1	1
PEDESTRIAN				
BACKING				
MISC.				
TOTAL		4	54	58

REMARKS

EXHIBIT 24

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT
ACCIDENT ANALYSIS

COLLISION DIAGRAM

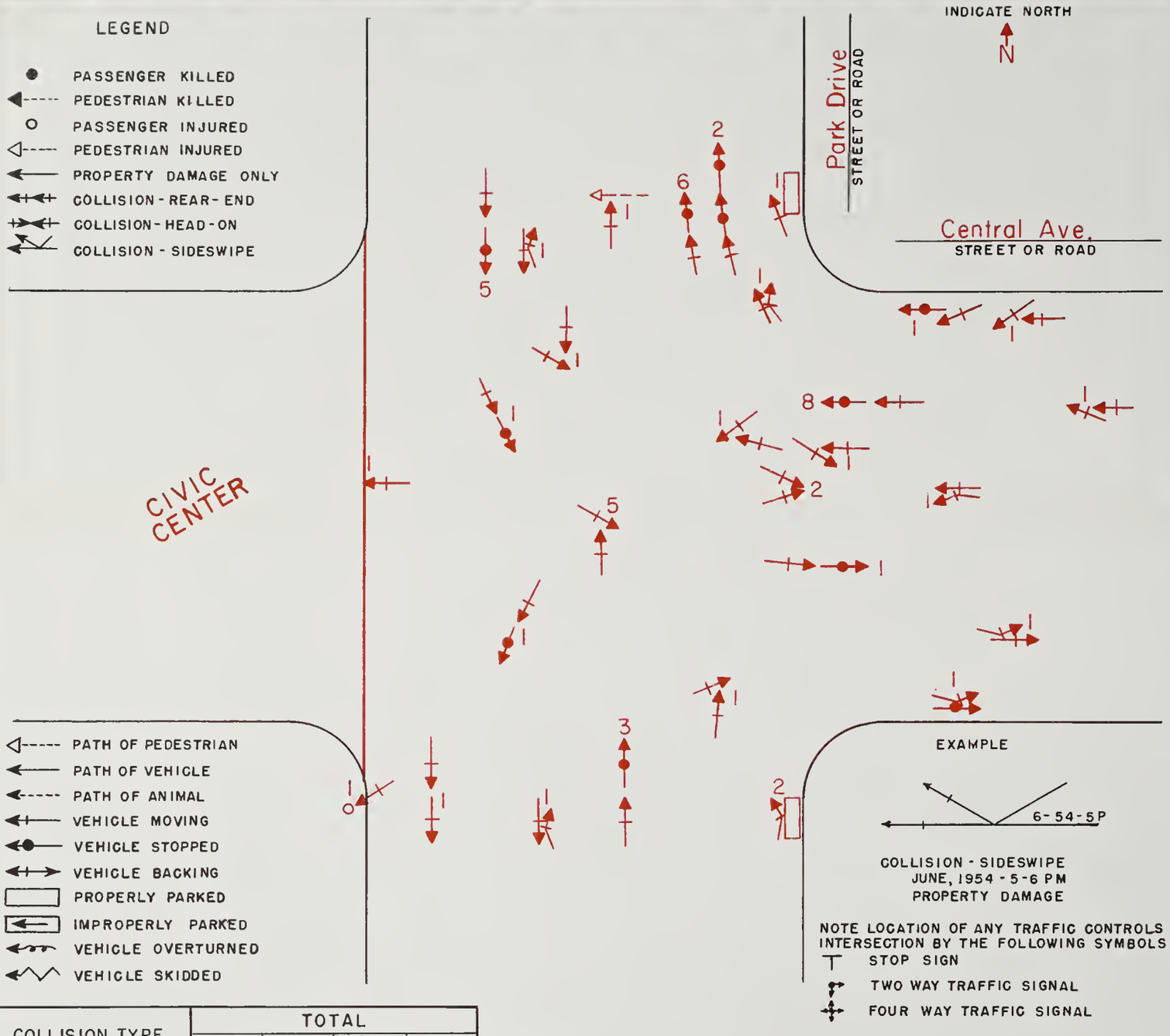
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF Central Ave. AND Park Drive

HIGHWAY NUMBER _____

PERIOD COVERED 1960 1961 1962

COMPILED BY _____ DRAWN BY _____ DATE _____



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			2	2
HEAD - ON				
REAR - END			26	26
SIDESWIPE			9	9
TURNING MOVEMENT			12	12
PARKING				
NON - COLLISION				
FIXED OBJECT			2	2
PEDESTRIAN		1		1
BACKING				
MISC.				
TOTAL		1	51	52

REMARKS _____

EXHIBIT 25

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT
ACCIDENT ANALYSIS

COLLISION DIAGRAM

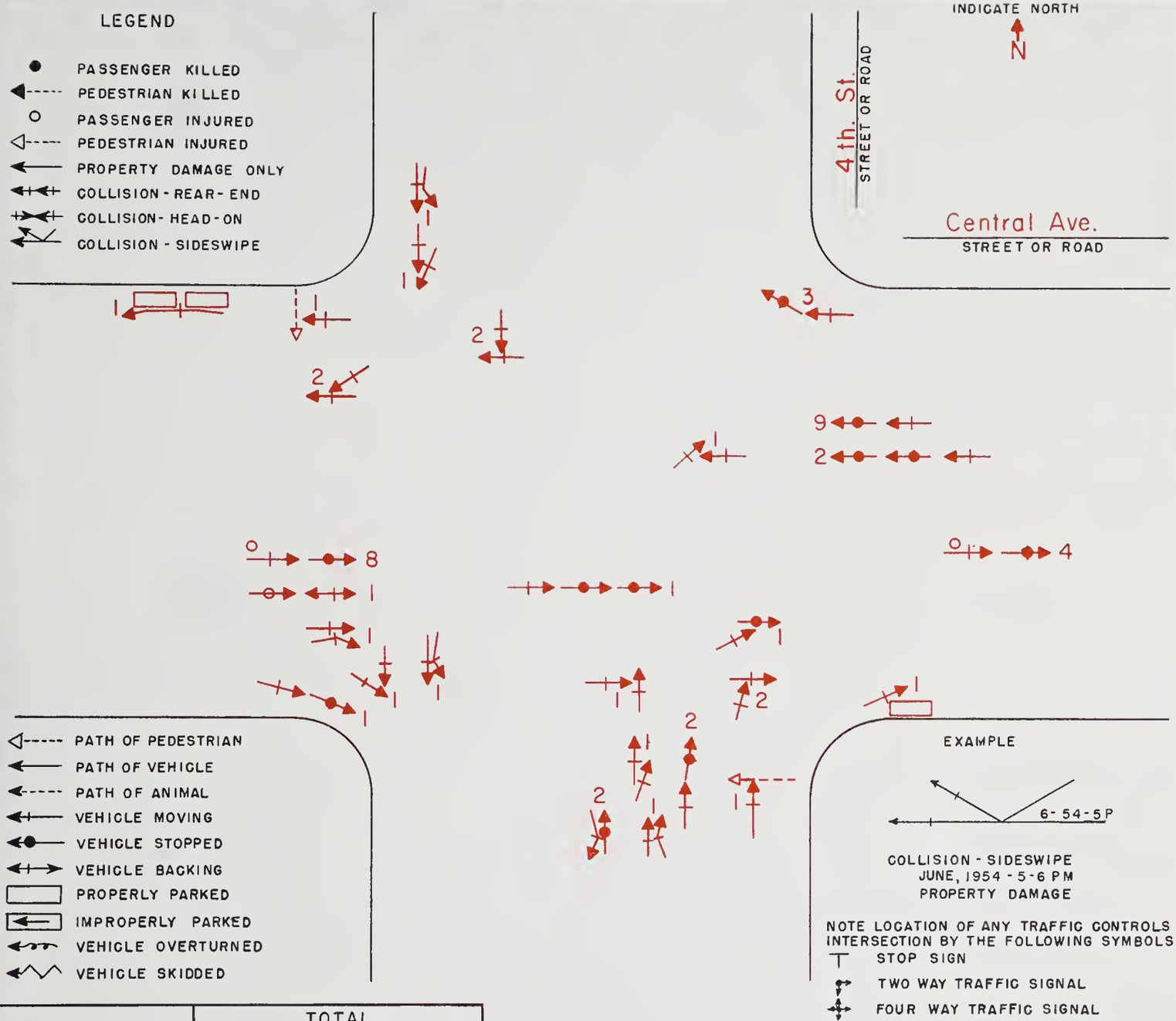
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF Central Ave. AND 4th. St.

HIGHWAY NUMBER

PERIOD COVERED 1960 1961 1962

COMPILED BY DRAWN BY DATE



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			3	3
HEAD - ON				
REAR - END		2	22	24
SIDESWIPE			5	5
TURNING MOVEMENT			15	15
PARKING				
NON - COLLISION				
FIXED OBJECT				
PEDESTRIAN		2		2
BACKING			1	1
MISC.			2	2
TOTAL		4	48	52

REMARKS

EXHIBIT 26

MONTANA HIGHWAY COMMISSION

TRAFFIC DEPARTMENT

ACCIDENT ANALYSIS

COLLISION DIAGRAM

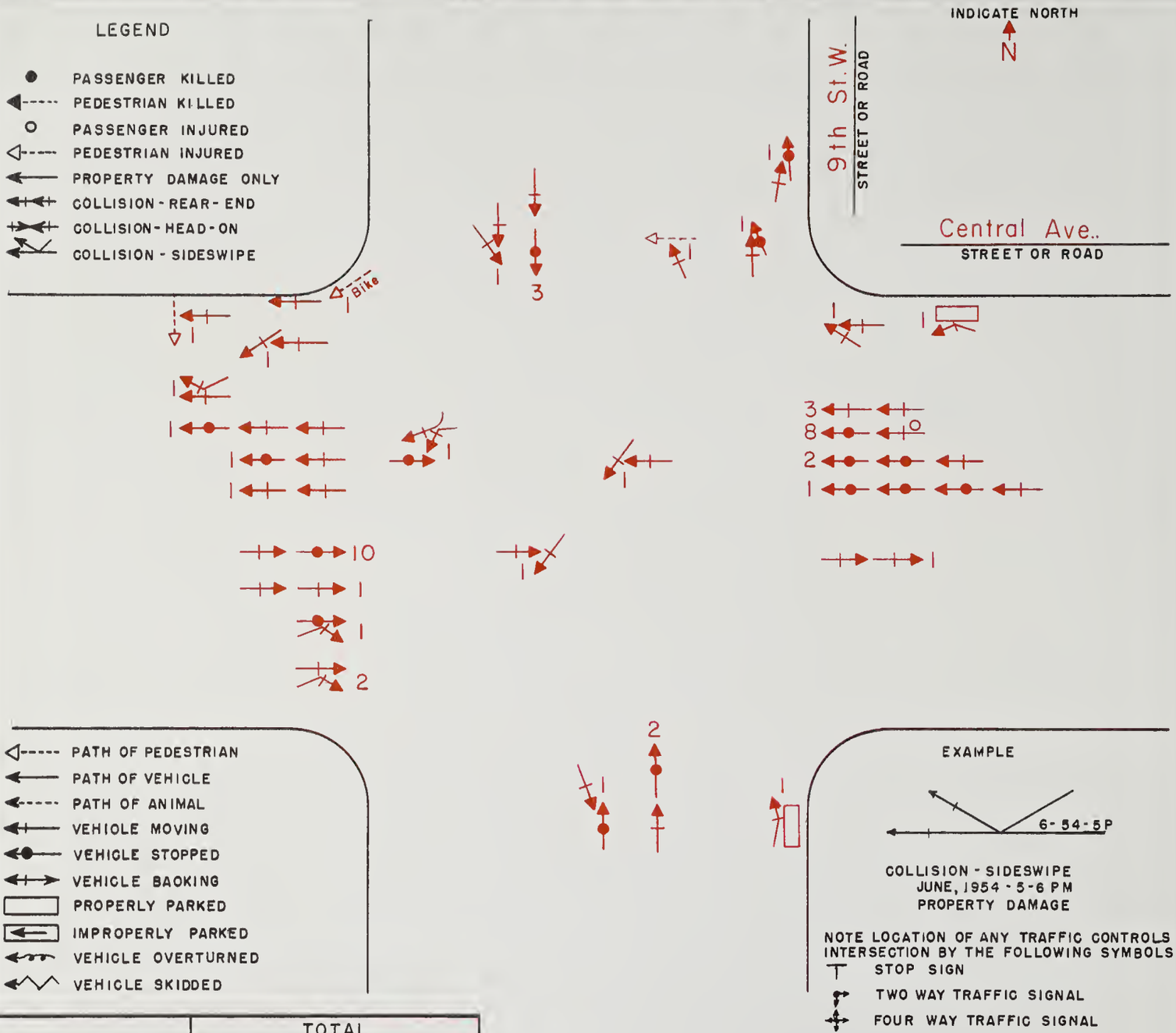
CITY OF Great Falls COUNTY Cascade

INTERSECTION OF Central Ave. AND 9th. St. W.

HIGHWAY NUMBER

PERIOD COVERED 1960 1961 1962

COMPILED BY DRAWN BY DATE



COLLISION TYPE	TOTAL			
	FATAL	INJURY	PROP DAMAGE	TOTAL
ANGLE			2	2
HEAD - ON				
REAR - END		1	33	34
SIDESWIPE			6	6
TURNING MOVEMENT			7	7
PARKING				
NON - COLLISION				
FIXED OBJECT				
PEDESTRIAN		2		2
BACKING				
MISC.		1		1
TOTAL		4	48	52

REMARKS

EXHIBIT 27

Traffic Assignment

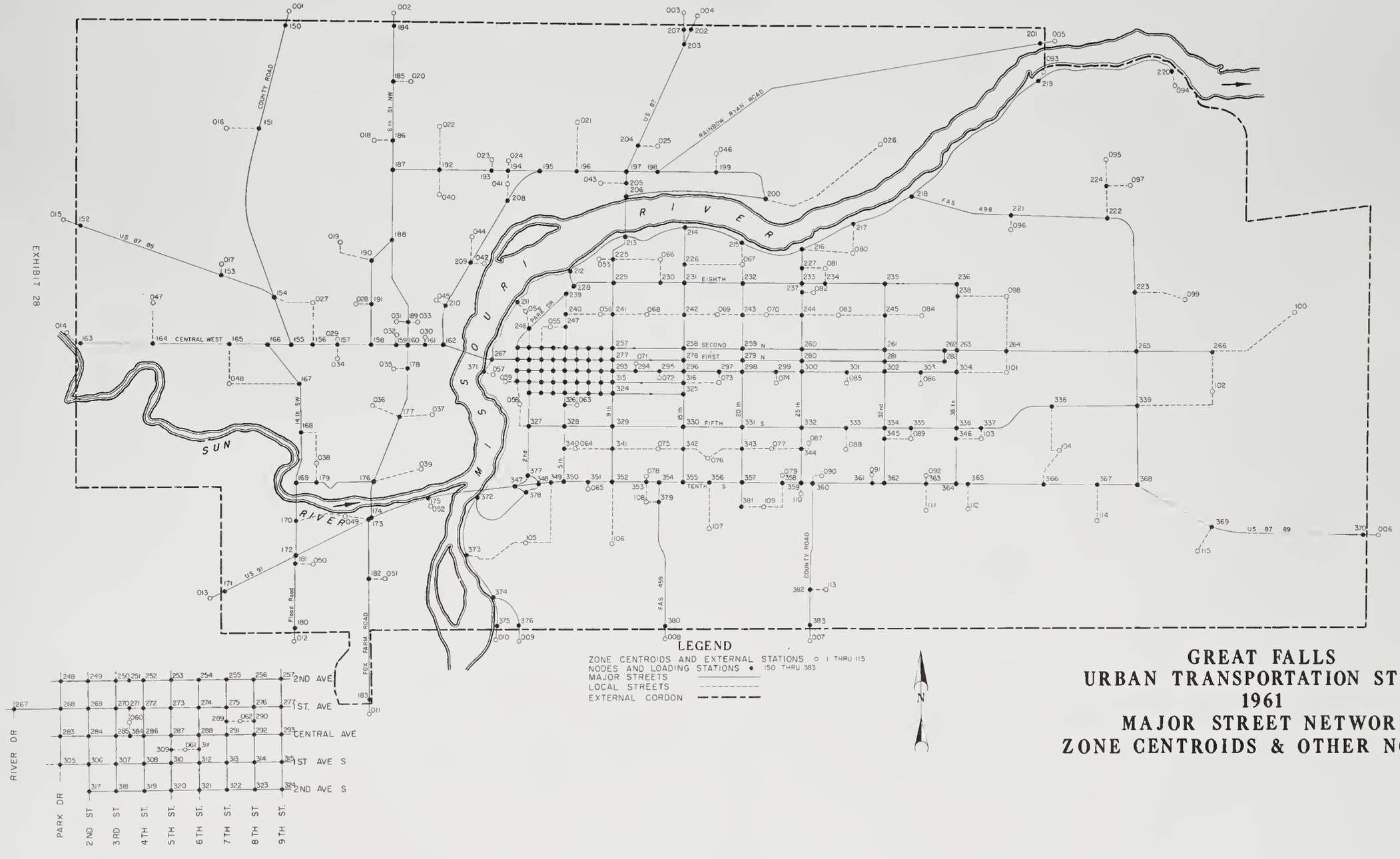
TRAFFIC ASSIGNMENT TO THE PRESENT NETWORK

Traffic assignment is a method of estimating the number of vehicles that will use a particular street section, street, or network in a given area. This estimation may be made for the present time or for any selected future year. Assignment procedures are used to determine the optimum location of future facilities and to provide the highway designer with the probable future traffic loads on a proposed facility.

Before the perfection of computer programs, the assignment of traffic to a proposed route or network was a tedious and time-consuming task. Trips obtained from origin and destination studies were usually manually examined and were then assigned and accumulated on the most logical route between the points of origin and destination. Needless to say, with so much hand labor involved, traffic assignments to alternate locations of a facility or to a complete major street network were usually impractical.

In 1957, a computer procedure for finding the shortest path through a maze was developed by Edward F. Moore of the Bell Telephone Laboratories. This procedure was found to be applicable to the assignment of traffic to a network, and with some refinements it has become the basis for most of the present high-speed computer assignment programs.

The first step in a computer assignment program consists of describing the highway network in an area in terms that may be used by the computer. This is accomplished by assigning a series of identifying node numbers to the street intersections, zone centroids, and external origin and destination stations within the area. The node numbers assigned to the Great Falls street network are shown in Exhibit 28 on page 67. The distance between nodes or the length of each link in the network is described to the computer in



GREAT FALLS
URBAN TRANSPORTATION STUDY
1961
MAJOR STREET NETWORK
ZONE CENTROIDS & OTHER NODES

terms of actual travel time. Travel time used in the assignment program was obtained by averaging two timed runs made during the off-peak hours with one timed run made during the peak hour of travel. Average travel time was obtained accordingly for each link of the major street network.

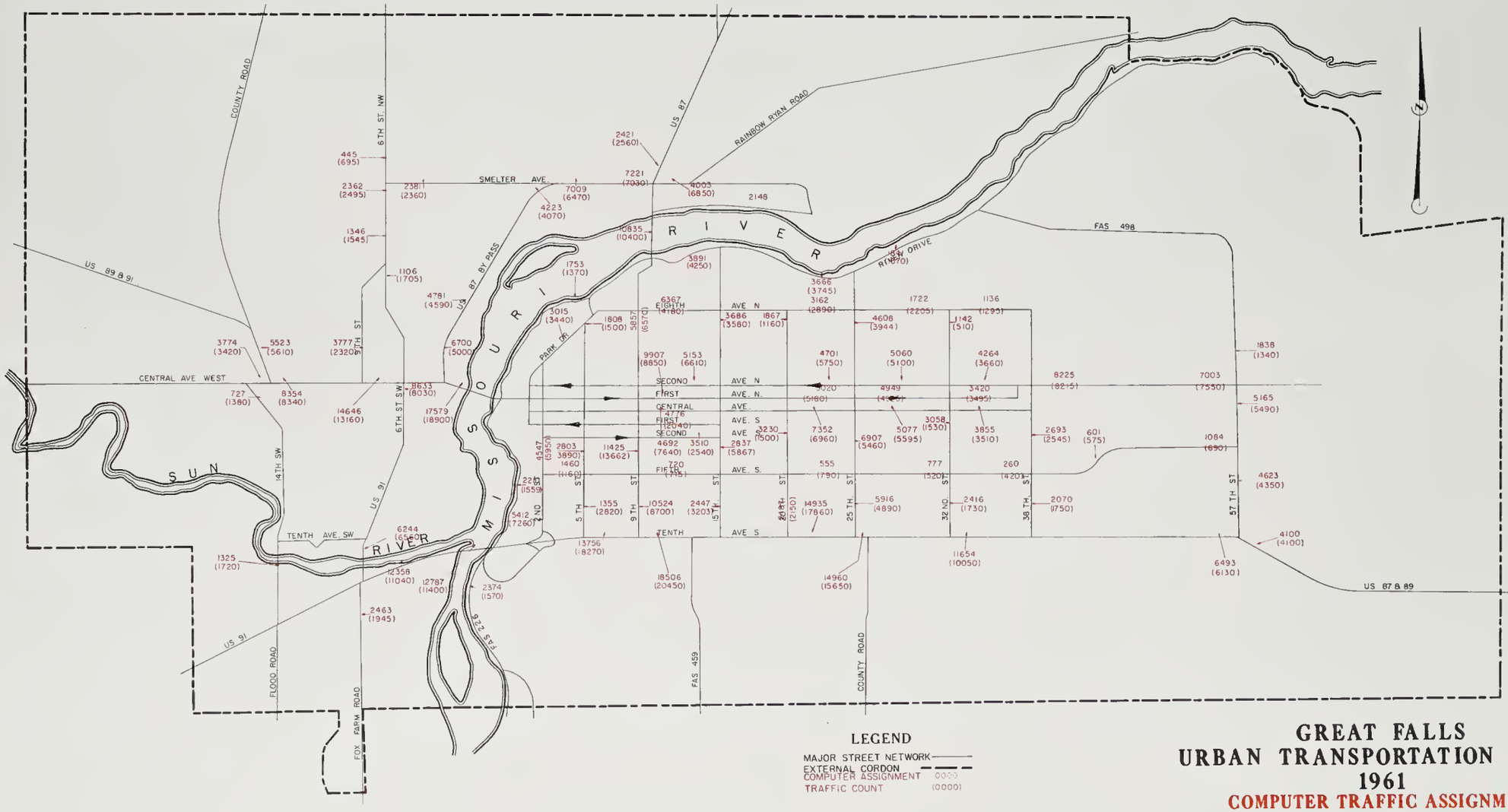
After the major street network has been satisfactorily described to the computer in terms of numbered nodes and travel time between nodes, the machine is able to quickly determine the routes through the network that have the shortest elapsed time from any one point in the urban area to all others.

Trips obtained from the various origin and destination surveys are loaded onto the network at the zone centroids and external stations. The zone-to-zone and zone-to-station traffic movements are then assigned and accumulated by the computer on the predetermined routes that had the shortest elapsed time between all points of origin and destination.

Assigned traffic volumes on each link of the network and turning movements at each node or intersection are the end result of the computer assignment program. Present traffic volumes between zones are usually assigned to the network by this method to test the accuracy of the program by comparing the assigned volumes with the actual counted traffic volumes on the various network links. Such a comparison in Great Falls is shown in Exhibit 29 on page 69.

Traffic volumes assigned by the computer program were generally in close agreement with actual traffic volumes counted on the ground. A comparison of the computer assignment of present traffic with actual ground counts at the Missouri River screen line is shown in the following tabulation on page 70:

EXHIBIT 29



LEGEND

MAJOR STREET NETWORK
EXTERNAL CORDON
COMPUTER ASSIGNMENT 0000
TRAFFIC COUNT (0000)

GREAT FALLS URBAN TRANSPORTATION STUDY 1961

COMPUTER TRAFFIC ASSIGNMENT

Location	Machine Assignment	Actual Traffic Count	Percent of Count
10th Avenue South Bridge	12,790	11,400	112.2
1st Avenue North Bridge	17,489	18,900	92.5
10th Street North Bridge	10,922	10,400	105.1
TOTAL	41,201	40,700	101.2

As stated in the introduction, the information contained in this Volume III, together with the information presented in Volumes I and II which have previously been published, will be summarized in Volume IV to present the principal findings of these reports as they apply to the present urban transportation situation in Great Falls and the surrounding urban area.

Attention will be directed to the critically deficient areas that exist in the present urban transportation service, and recommendations will be made for corrective action. Of equal importance, however, is the certainty that present deficiencies will become more critical as the city and urbanized area grows in future years with corresponding increases in traffic volumes. Situations which are tolerable under present conditions will soon become intolerable as the area grows, and a properly developed urban transportation plan must anticipate and give consideration to future developments as well as present situations.

It is generally accepted that future planning should encompass a period extending twenty years in the future. In order to plan for future transportation requirements, it will be necessary to estimate the future population growth for a twenty-year period within the urban area, and this growth must be distributed by zones. Consideration must also be given to future land use, economic development, and employment opportunities within these zones.

When these factors are developed, it will be possible to estimate the

number of future trip ends generated by each zone, and through use of the traffic assignment procedures described in this section, it will be possible to assign the inter-zonal trips to a major street system and related facilities which will be required to meet future urban transportation requirements.